JANUARY, 1954

METAL FINISHING

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

FOUNDED 1903

Technical Developments of 1953
A comprehensive survey of the finishing trade and patent literature

Converting Polishing Lathes to Belt Polishers

Plating in the Near East — Turkey and Cyprus

Manufacture of Embossing Plates and Dies by Electroforming

Phosphoric Acid Anodizing as a Pretreatment for Plating on Aluminum

Complete Contents Page 49

E. Engn
Wahl

METAL FINISHING

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

Founded as Metal Industry, January, 1903
by Palmer H. Langdon, 1868-1935

Published Monthly by

FINISHING PUBLICATIONS, INC.

Serving the electroplating and industrial coating fields with specialized monthlies and guidebooks since 1903. Companion publication, ORGANIC FINISHING.

Editorial, circulation and publishing office at 381 Broadway, Westwood, New Jersey. Telephone WEstwood 5-1530. District advertising sales offices at 19 Elmwood Place, Harnell, New York, telephone Harnell 943, and 742 So. Hill Street, Los Angeles 14, California, telephone MAdison 6-5421.

Member

CCA — Controlled Circulation Audit

NBP — National Business Publications

Society of Business Magazine Editors

Subscription Information

United States and Canada $4.00 per year, other countries $8.00. Single copies 45c in U. S. and Canada, other countries 85c. Annual subscription to both METAL FINISHING and ORGANIC FINISHING, including annual GUIDEBOOKS, $5.00 U. S. and Canada.

GUIDEBOOK-DIRECTORY 22nd edition 1954 current, 566 pages 5¼ x 7⅞ $3.00. Please remit by check or money order; cash should be registered. All correspondence should be directed to **381 Broadway, Westwood, New Jersey.** Publisher reserves the right to reject any subscription which does not conform to his standards of buying power coverage. Request for change of address should reach us on or before the 15th of the month preceding the issue with which it is to go in effect. It is difficult and often impossible to supply back numbers to replace those undelivered through failure to send advance notice. In sending us your change of address please be sure to send us your old address as well as the new one.

 Re-entered as second class matter June 13, 1940 at the post office at New York, N. Y. under the Act of March 3, 1879.

JANUARY 1954 VOLUME 52 • NUMBER 1

CONTENTS

Editorial 51

Technical Developments of 1953 52
By Nathaniel Hall

Converting Polishing Lathes to Use Coated Abrasive Belts 62
By J. J. Durnan

Electroplating in Turkey and Cyprus 64
By Marvin Rubinstein

Plating on Aluminum 70
By Bernard E. Bunce

Electroforming Embossing and Graining Plates 74
By Elias Schore

Shop Problems 77

Patents 79

Recent Developments 82

Business Items 92

News from California 103

Obituaries 106

New Books 107

Letters to the Editor 108

Technical Literature 109

Motor City Plating News 110

Associations and Societies 113

Manufacturers' Literature 120

COMING SOON

Operating characteristics and technical advantages of emulsifiable solvent cleaning.

A practical, simple and accurate method of plating on lead alloys, pewter and Britannia.

Results obtained with electroless barrel nickel plating in commercial production.

Review of investigations carried out on the compositions of the complexes formed in cyanide copper plating baths.

JANUARY 1954

LEA COMPOUND

A greaseless composition for polishing, buffing, burring and satin finishing.

Lea Compound is a greaseless composition containing an abrasive or mixture of abrasives bonded together with glue. When applied to a revolving wheel sufficient heat is generated by friction to cause the compound to melt and be transferred to the wheel. Almost immediately it dries or sets up, forming a dry, abrasive-coated wheel with a flexible surface. The use of Lea Compound provides a short cut between polishing and buffing, eliminating polishing wheels in the finer numbers and

rendering easier the job of buffing and coloring.

Lea Compound is not limited to rigid polishing wheels but can be successfully applied to cloth, leather and string wheels of any degree of flexibility. On sewed muslin buffs, pocketed buffs, full-disc loose buffs, packed buffs and string wheels, a degree of flexibility never approached by the conventional set-up wheel is available to the operator.

While the abrasive grains are held securely to the surface of the wheel, the extreme flexibility of the wheel combined with the thin layer of abrasives avoids holding the grains in a rigid position. Therefore, they do not cut as deeply into the surface as grains of a set-up wheel would. Flexibility of the Lea Compound wheel cushions the cutting action of the abrasive grain, whereas with conventional polishing wheels this effect can be obtained only by the use of excessive lubrication.

LEAROK

A no-free-grease buffing composition for high lustre or mirror finishing. A special process developed by Lea Technicians has resulted in the production of Learok buffing and coloring compositions containing no-free-grease. This process of manufacture enables the production of compounds differing materially from the ordinary type of buffing and coloring compositions which contain excessive amounts of grease not absorbed by the abrasive powders. Having no-free-grease to transfer back from the work, the use of Learok eliminates the necessity of scrubbing or excessive cleanings.

Savings are particularly noticeable when work containing contours, ornamentations or filigreed decorations is being buffed, or when work such as drawn shells, which must be handled on chucks, is being finished. Learok may be used on such materials as aluminum, brass, carbon steel, copper, hard rubber, nickel alloys, pewter, plastics, stainless steel, sterling silver, etc.

OTHER LEA PRODUCTS INCLUDE

LEA LUBAR . . . a bar form lubricant for polishing wheels and belts where glazing is not a problem.

cLEAn GRAIN LUBAR . . . a special bar form lubricant to eliminate glazing on polishing wheels and belts.

LEA LIQUALUBE . . . a water soluble liquid lubricant for polishing wheels and belts; can be sprayed or brushed on.

AD-LEA-SIVE . . . glue base adhesive for sizing buffing and polishing wheels and belts prior to the application of Lea Compound.

LEABRAMENT . . . greaseless, non-flammable, quick drying liquid abrasive, for burring and polishing; can be sprayed or brushed on the wheel.

LEA LIQUABRADE . . . clean working, fast cutting and mirror finishing liquid buffing compounds providing in effect continuous operation and substantial economies in composition and buffs; clean and safe, non-inflammable, non-explosive; many abrasive types and grain sizes for all ferrous and non-ferrous metals, steel, stainless alloys, or plastics.

LEA SYNSTRIP . . . a high speed liquid stripper for synthetic enamels and other organic coatings; leaves non-ferrous surfaces smooth; no etching.

LEATARDENT . . . anti-stain, dipping emulsion; prevents staining and tarnishing of plated surfaces.

LEA ANALYTICAL METHODS . . . platers' short-cut methods for analyzing plating solutions.

THE LEA MANUFACTURING CO.
16 CHERRY AVE., WATERBURY 20, CONN.

Lea-Michigan, Inc.
14066 Stansbury Ave., Detroit 27, Mich.

Lea Mfg. Company of Canada, Ltd.
370 Victoria St., Toronto 2, Canada

Lea-Ronal, Inc.
Main Office and Laboratory
42-48 27th St., Long Island City 1, N. Y.

Manufacturing Plant
237 East Aurora St., Waterbury 20, Conn.

LEA GRIPMASTER®
POLISHING WHEEL CEMENT
matching the high quality of other Lea Products, is now obtainable through
LEA-MICHIGAN, INC.
14066 Stansbury Ave., Detroit 27, Mich.

ESTABLISHED 1903

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

METAL FINISHING

VOLUME 52 • NUMBER 1 • JANUARY, 1954

1874 - 1953

It is with heavy heart and heavy hand that I must sorrowfully inform our readers of the passing of Mister Plating, for with George Hogaboom goes our strongest link to an era of great platers, men who started with nothing but an interesting art and developed it into a universal production tool.

Without formal education but with the will to succeed, he added hard-earned experience to his natural abilities to the extent that he eventually was granted a license as Professional Engineer and, as testimonials to his sincere devotion to the furthering of scientific knowledge, he has left behind him a famous textbook, numerous patents and innumerable published articles.

The most distinguished and probably the best known member of the group of "old timers" who have been looked up to for decades as the guiding forces responsible for the present accepted state of electroplating as a modern industry, he gave unselfishly of his time and effort. A host of platers are indebted to him for assistance in furthering their careers. I personally owed him a debt of gratitude which could never be repayed. To the younger men he was "Mister" Hogaboom, to the others "George", but to me he was "Pop" for eighteen years and I will never forget that his helping hand was never withheld.

George Hogaboom received many honors in his lifetime and was deserving of many more. Now he is gone and we will all miss him. But there is no more fitting farewell for any man than to say he will be missed.

Nathaniel Hall

Technical Developments of 1953

By **Nathaniel Hall**, *Technical Editor*

Cleaning

ALTHOUGH there were no developments of outstanding importance in this phase of the metal finishing art, a number of interesting articles and patents appeared during the year. A comprehensive *survey of cleaning processes*, including a comparison of standard methods was assembled by Campbell,[1] and Gray[2] summarized the progress of Research Project 12 of the American Electroplaters' Society, dealing with *alkaline soak, electrolytic and spray wash procedures*. The use of *sequestering agents to minimize sludge formation* in caustic soda baths used to clean and etch aluminum was described by Prescott, Shaw & Lilker,[3] while Hedman & Miller studied the problems involved in *cleaning fine instruments*,[4] as a result of which they concluded that triethanolamine oleate gave excellent results.

A patent on a *solvent vapor degreaser* granted to Jones & White[5] was the only development in this field culled from the literature but *emulsion solvents* were the subject of one article by Osipow, Segura Jr., Snell & Snell[6] who compared them with *diphase systems* for removing soil, finding the latter much more rapid, and of two patents, one to Thomas on a diphase process for cleaning steel and zinc base diecastings[7] and the other to Dodd & Ainsley for a water-dispersible *acidic emulsion cleaner*.[8]

A unique method for cleaning ferrous metals which removes both carbonaceous material and oxide was patented by Cone & Huebler,[9] involving heating at high temperatures in an atmosphere oxidizing to carbon and reducing to iron oxide. Cleaning equipment was covered in two patents, one to Rule on a machine including a *built-in pressure spray*[10] and the other to Kurt on an automatic machine with *oscillating nozzles*.[11]

In the field of abrasive blasting, three articles were worthy of note. *Wet blasting* as a method of surfacing die casting dies was discussed by Anderson[12] while Dill described the use of abrasive blasting for *cleaning steel strip in continuous lengths*.[13] The subject was also surveyed in an article by Colegate,[14] who covered both dry and wet methods. The patent situation was more active, *wet blasting machines* being claimed by Ransohoff[15] and by VanderWal[16] while dry machines were disclosed by Bishop & Finn for *blasting the edges of sheet*,[17] for *cleaning castings* by Webster[18] and for *use with soft abrasive* by Newell.[19] An *abrasive gun* was claimed by Berg[20] and a *sandblast nozzle* by Kroll.[21]

Pickling

This was a very popular subject during the past year, even the materials of construction of the future receiving some attention. *Titanium*, which has been quite prominent in recent months, was found to react favorably to descaling in *fused salt baths* and Sittig[22] suggested operation of the sodium hydride bath at below 700°F. to eliminate burning through thin sheet. For light scale, the fused bath was found to be unnecessary, according to Durkin,[23] acid dips being satisfactory. Patents were granted to Levesque for a solution of nitric acid followed by hydrochloric acid, without an intermediate rinse, to remove oxide from *molybdenum wire*[24] and to Dilling & Frederic for a solution of hydrofluoric and nitric acids containing lead nitrate and free lead for the removal of scale from *zirconium and its alloys*.[25]

In connection with the *pickling of steel*, new solutions developed included a mixture of chromic, fluoboric and nitric acids, followed by fluosilicic acid, patented by Floersch,[26] a solution of oxalic acid plus iron and aluminum chloride claimed by Rosenfeld & Pickett,[27] and a most unusual method, which will probably not be readily adopted by platers, involving *soaking in blackstrap molasses for 6 days*, followed by a dip in a solution of sodium bicarbonate in water, invented by Criddle.[28]

Addition agents such as *inhibitors* were patented by Irwin,[29] Sundberg, Albus & Cross,[30] Morris[31] and Carroll,[32] the last on a method of reducing delay in foam formation when a foaming agent is employed. Scale removal with *inhibited acids* was discussed by Bailey,[33] who covered the mechanism of scale removal, inhibitors, and their action.

Fused baths were claimed in four patents, one on alkali metal nitrate and nitrite containing an alkali metal oxide, patented by Pakkala & Phillips,[34] a molten alkali metal salt containing an oxidizing agent employed for continuous processing by Dunlevy, Frick & Shoemaker,[35] and a fused bath of caustic soda, alkali metal nitrate and sodium borate by Clingan.[36] An interesting variation claimed by Faler[37] involved draining in air to cool the articles, followed by the usual rinse.

The use of fused baths for *picking stainless steel* was the subject of an article by Evans[38] who described the descaling of tubing in the sodium hydride process. A *fused bath* of hydroxide and nitrate with a small amount of alkali metal oxide was patented by Francis.[39]

A modication of the more conventional acid bath, consisting of a solution of nitric, hydrochloric, phosphoric and sulfuric acid was the subject of a patent issued to Swihart.[40]

Equipment, specifically *carbon and graphite*, was discussed by Revilock[41] and treated in patents granted to Dunnegan & Ogle,[42] Campbell[43] and Howes.[44] Other patents noted included heating to about 300°F. and immediately dipping into a hot pickling bath, granted to Drews & Farling,[45] application of a completely oxidized polyvalent metal halide to form a coating and then heating to loosen the scale, followed by quenching to break the scale away, disclosed by Brodell[46] and a method involving *rolling of strip to break apart the scale* which is then removed chemically, developed by Pottberg.[47]

Pickling of *copper and its alloys* was the subject of one article by Halls,[48] who surveyed the effects of different acid and acid mixtures used for pickling and bright dipping, and one patent granted to Snyder & MacLelland[49] on a process of heating in a halogen bearing atmosphere and cooling, whereby the scale easily separates. *Tarnish removal* from copper and other metals such as silver and gold was covered in an article by Brenner[50] which described *acid solutions of thiourea*, and in a patent by Lowenheim[51] who claimed a similar solution.

Polishing

Mechanical

The most important contribution in this field during the year was the study by Pinner[52] of the *effect of abrasive polishing* of the base metal *on the character of the subsequent nickel deposit*, which led to the conclusion that base metal imperfections such as slag inclusions and pits have a most pronounced effect on the corrosion resistance of the plate. Fragmented metal particles produced by the abrasive were found to be extremely damaging but anodic etching in sulfuric acid tended to overcome this condition.

Three other articles were worthy of note. The principles of *inside polishing and buffing* with small bobs and buffs were discussed by Doyle[53] and polishing cycles and *finishes for stainless steel* were described by Spencer.[54] The granting of no less than twenty patents on buffing and polishing wheels of various kinds was noted with some surprise but, because of space limitations, they are not being detailed here. However, we believe that three patents in connection with *buffing compounds* are worthy of inclusion. These are the use of finely divided *zirconium oxide* as a polishing agent, claimed by Miller,[55] a method of producing *lime buffing compound* in cakes with an impervious skin granted to Stier[56] and a *spray gun nozzle* for applying liquid compositions developed by Smith.[57]

In contrast to the situation during 1952 during which year *belt polishing* received only very slighting treatment in the literature, the past year was quite fruitful by comparison, although evidenced mainly by patents rather than by technical articles. Durnan explained the procedure for *converting polishing lathes from wheels to belts* by simple addition of backstand idlers[58] and in another article,[59] the same author described some *novel set-ups for getting into recesses* with abrasive belts. Belt polishing *machines* were patented by Zimmerman,[60] Kniep[61] and Hendrickson.[62] Other patents in this field were a device for *dressing glazed belts*, granted to Brink[63] and a method of *dressing the contact rolls*, claimed by Boehm.[64] They also included *a belt for curved surfaces* issued to Nuessle[65] and *a flexible contact wheel* of novel design, invented by Cosmos.[66]

The year's literature included only one more article of interest, in which Peterson pointed out that the *finish produced by the use of brushes*[67] may appear duller than a buffed surface but the roughness can be reduced from 24-35 microinches to 4-7. Among the patents could be found two on *dust collectors*, granted to Bruckner[68] and to McIlvaine & Yates,[69] *a wheel balancer* claimed by Anderson[70] and a *buffing lathe* disclosed by Clyne.[71] *Automatic polishing and buffing machines* were described in patents granted to Wing,[72] Zinn & Perkins,[73] Kinker & Murtach,[74] and Burt[75] but the most interesting one was for a hopper-fed machine for *polishing the heads of screws* and similar articles, developed by Knight.[76]

Electrolytic

On the academic side, the *limiting current density* of metal dissolution in electropolishing solutions was studied experimentally by Hickling & Higgins,[77] using the potentiostat technique. Their results indicated that the primary condition necessary for electropolishing is that the limiting current density of metal dissolution must be exceeded in an electrolyte in which the metallic oxide is soluble. Edwards, as a result of his study[78] concluded that the *mode of smoothing* results solely from the variations in concentration gradient within the diffusion layer set up on the anode surface. For any surface of known shape there is, therefore, a maximum possible smoothing efficiency.

On the practical side, Charlesworth & Hobson[79] pointed out the applications of *electropolished stainless steel* and its advantages while Wernick & Pinner surveyed the field of electropolishing with regards to *aluminum*.[80] New patents included the *treatment of aluminum* by cleaning in phosphoric-chromic acid mixture, anodizing in solution of alkali metal phosphate and aluminate, then treating in the phosphoric-chromic mixture again to produce highly reflective surfaces. This process was claimed by Freud.[81] According to Sullivan,[82] *sterling silver* could be electropolished in a cyanide bath while moving the anode in and out of the bath at the rate of at least 10 cycles per minute. An *electrolyte* was patented by Axtell[83] consisting of phosphoric acid plus a polyhydric alcohol, a monohydroxy mono-carboxylic acid, water and an addition agent, while Walton claimed[84] that this type of *bath could be regenerated by addition of oxalate* in amount just sufficient to precipitate the dissolved metals.

Chemical

There was no development in the field of chemical polishing or bright dipping, as it is more familiarly known, to compare with the previous year when Marshall reported the results of his work on iron and steel. The only article worth reporting, in addition

to those mentioned previously in the section on pickling, is one by Pinner[85] on the *theory and practice* as it pertains to all commonly employed metals. The patent literature, however, was more productive, bringing forth a method by Terhune[86] of *polishing aluminum* in a hot alkaline solution containing a dispersion of a copper bearing material. *Acid solutions were* patented by Shelton-Jones[87] who claimed a hot phosphoric acid-water solution, Hesch[88] who claimed a hot acid nitrate solution containing fluoride ions, and Cochran[89] who patented a hot solution of phosphoric acid, nitric acid and water. The novel method of *maintaining an aluminum bright dip* by discarding a portion of the bath and replacing it with fresh dip according to the amount of work processed was the subject of a patent granted to Prance & Reindl.[90]

The patent literature was also responsible for methods of polishing other metals, Zelley[91] claiming a hot bath of phosphoric acid, nitric acid, sulfuric acid and water for *bright dipping nickel.* Passivating *bright dips for cadmium and zinc* were claimed by Ostrander[92] who suggested a solution containing chromic, sulfuric and acetic acids and by Faucher[93] who claimed a mixture of chromic, sulfuric, phosphoric and nitric acids.

Barrel Finishing

Although this method of smoothening metals would ordinarily be included with mechanical polishing, there was a surprising amount of activity during the past year, sufficient to warrant separate treatment. And even more surprising, none of the developments in the literature consisted of patents. Examples of *clamps and fixtures for tumbling large parts* without colliding were described by Stone.[94] This is a field in which mechanical ingenuity could broaden the applications of barrel finishing tremendously. Marble discussed a number of *problems which arise* and suggested means for their solution, all from a practical standpoint.[95] Terry covered *steel burnishing shapes* and their employment in the barrel finishing process[96] while Colegate covered the whole field of burnishing and deburring in a survey of *equipment and practice.*[97]

Barrel deburring and polishing with abrasives and stones were the subjects of a number of papers. *Abrasive compounds and lubricants,* together with their effects and their proper employment were detailed by Pinke.[98] Desirable *characteristics for minerals* to be used in barrel finishing were explained by Beaver[99] and *burr removal* was the subject of an article by Ashmead, who described the deburring practice at Ryan Aeronautical Co.,[100] and another by Larsen who discussed burr removal by *wet tumbling.*[101]

Aluminum — Plating and Anodizing

Main efforts in connection with plating on aluminum have understandably been to improve adhesion. Double zincate treatment, now commonly employed, was discovered by trial and error. We have a tentative *explanation for the improved adhesion,* thanks to the efforts of Edwards & Swanson,[102] who proposed that this is due to improvement in uniformity of the oxide film on the aluminum when the zincate film is applied, stripped off and reapplied prior to plating.

A welcome improvement in the zincate process was due to Zelley[103] who investigated *dilute zincate baths* and found them to be quite saitfscatory. He too used the double zincate treatment, incidentally. Other modifications of the zincate process included a patent issued to VanderHorst[104] on the improvement involving *vapor blasting* with a mixture of air, water and abrasive to break down the oxide film prior to zincating and one to Calderon & Slomin [105] on a *process including a strike* in a copper-zinc cyanide solution containing silver, gold or indium at pH 9-10.

Processes which do not involve the zincate dip in the cycle were also investigated. Bunce[106] described his experience with the *phosphoric acid anodizing pretreatment* for producing adherent electrodeposits and Ore[107] recommended a cycle which included *electrodeposition of zinc or brass from a special solution* prior to regular plating plus a post-plating heat treatment. The process was claimed to produce deposits superior to those produced by the zinc immersion process and to be simple in operation. From the description of the process given in the paper, the latter is open to question, however. One patent of interest covered the production of *severely drawn aluminum articles* by first nickel and chromium plating, then heat treating at 750-800°F. This process, claimed by McKay[108] involves a temperature appreciably higher than that employed by Ore, above.

On the subject of *anodizing of aluminum*, the literature produced two articles and two patents which might be considered noteworthy. From the academic standpoint, the *structural features of porous types of anodic oxide coatings* were investigated with the electron microscope by Keller, Hunter & Robinson.[109] This paper included a pertinent discussion of coatings formed in sulfuric, chromic and phosphoric acid electrolytes. Along practical lines, a study by Tajima, Kimura & Fukushima[110] of the *effect of different protective anodizing processes* on the reflectivity of brightened aluminum established optimum concentration conditions for the oxalic, sulfuric and sodium bisulfate baths at 5% by wt., 2% by volume and 20% by weight respectively. Patents consisted of a *rack for anodizing hollow containers* which are filled gradually with the anodizing solution, claimed by Saffel[111] and a method of *impregnating the anodized film with resin* by exposing to the vapors of same in a closed container at above 200°F., claimed by Mason & Cochran.[112]

Plating On The Difficult Metals

Although most of the emphasis was on magnesium, the newer metals of industry also received attention during the year. A complete survey of the subject of *plating on magnesium* was presented from the production standpoint by DeLong,[113] who included processing and data on the protective value of the coatings. The author also was granted two patents, one[114] on the *addition of an inorganic fluoride* to the cyanide plating solution at pH 9-13, and the other on *prevention of blisters on castings* which are heated to above 450°F. by heating the plated castings at 250-450°F. for 4-16 hours.[115] One other patent was granted on a new process for producing adherent electrodeposits. Issued to Higgins,[116] it involves application of an *immersion deposit of zinc, cadmium or manganese,*

dipping in chromic acid solution to passivate the surface, followed by immersion in a mercury salt solution before plating.

Plating processes were developed for a number of metals which have not, as yet, been considered commonly used base materials. Colner, Feinleib & Reding[117] found that *adherent deposits could be produced on titanium* by first etching anodically in an essentially non-aqueous bath of hydrofluoric acid and ethylene glycol. Two methods for *plating on beryllium* were suggested by Beach & Faust,[118] one using a zincate dip similar to the procedure used for plating on magnesium and the other direct plating after activiation of the surface.

Schickner, Beach & Faust[119] found that *adherent deposits could be produced on zirconium* by etching under suitable conditions, iron or nickel plating and diffusion bonding the deposit at elevated temperature and Korbelak described a process[120] for *plating on molybdenum*, which involved anodic sulfuric acid treatment, followed by a chromium deposit and then a nickel deposit from the nickel chloride strike solution. Regular deposits of nickel and other metals followed. The chromium was stated to serve as a barrier against diffusion and blistering at high heat.

Metallic Coatings

Nickel

Although the production of nickel deposits by chemical reduction, commonly called "*electroless nickel*" was the topic of prime interest in this field, with the assistance of a bit of good press-agentry, no really new developments were introduced which might be considered important improvements over the original process as described by Brenner et al. a few years ago. However, for the first time, a short paper appeared by West,[121] in which complete details were given concerning *practical production*. The author found that elimination of the ammonium chloride from the original formula resulted in longer solution life and brighter deposits. Another paper, by Gostin,[122] also discussed the process from a production standpoint together with the *characteristics of the deposit* but gave no information on the solution composition, while Campbell[123] compared electroless deposits with electrodeposits. Improvements were claimed in patents granted to Talmey & Crehan,[124] Gutzeit & Krieg[125] and Gutzeit & Ramirez[126] and in interesting *combination of hypophosphite reduction and electrolysis* was the subject of a patent issued to Bonn & Wendell.[127]

Two interesting studies came to light during the year, one on the *effect of temperature on cathode potential* during nickel plating, in which Turner[128] developed an empirical equation to express the relationship, and the other a metallographic *study of some steels used for nickel plating*. In this paper Westman & Mohrnheim[129] described major differences between steels and indicated that the *basis metal is a contributing factor in coating failure*, which brings to mind the many years that "Mr. Plating" has been admonishing the industry to look at "what is under the plate."

Of more direct interest to the nickel plater might be the study of the *effects of chromium contamination* of the solution. Ewing, et al.[130] confirmed that a sufficient amount of hexavalent chromium will prevent deposition. They also pointed out that *electrolysis below 40 ASF was unsatisfactory* for removal. Also, Richards[131] listed a great number of causes of *peeling of nickel deposits* and suggested methods for their their control, while Schore suggested *activation cathodically* in a sodium cyanide solution to produce adherent deposits on nickel-silver,[132] operation of the bright nickel at pH 3.0 colorimetric to minimize stresses also being included in the recommendations. The use of *refinery cathode sheets as anodes* without the necessity for expensive recasting to make the metal soluble in plating solutions may be in the offing as a result of the claim by Case[133] that heating to between 2200°F. and slightly below the melting point of the nickel resulted in the formation of a grain structure suitable for anode use.

Bright nickel was investigated by Swanson[134] from the standpoint of roughness and his paper described the *different kinds of roughness* and the types of particles causing them. Seventy-six organic compounds were examined by Roth & Leidheiser[135] for their effects, in the course of which the authors concluded that *brittleness, peeling and cracking were associated with high polarization*. One patent was granted on a method of *preparing articles for bright nickel plating*, to Vogt & Herbert[136] involving anodic treatment in a special nickel bath, followed by anodic and cathodic treatment in a cyanide-carbonate solution.

A year ago we remarked that researchers must be pretty well satisfied with the present status of bright nickel solutions since only one brightener was patented during 1952. The issuance of eleven patents during 1953 would indicate that interest has not been declining at all, claims being granted to DuRose,[137] Portzer & Leitenberger,[138] Shenk,[139] Brown,[140] Donnelly[141] Brown & High,[142] Little[143] and Ellis.[144]

Chromium

The most novel development in this field last year was the modification of the old acetic-chromic acid bath for producing *black chromium deposits*, presented by Quaely.[145] Addition of a nickel or vanadium salt or both was found to eliminate the necessity for low temperature operation in the old bath, which required large refrigeration capacity. Now, if the current requirements of 700-1850 ASF at 12-15 volts could also be reduced to some reasonable figure, a process of broad application would be added to the plater's list.

In the field of production, Burt[146] described the plating of *aluminum die-cast engine cylinders*, Blount presented a generalized discussion of *hard chromium plating tools, molds and dies*[147] and Cabble[148] studied the *effect of chromium plating on the fatigue limit of steel*. Bonem detailed the use of *statistical quality control* in chromium plating cotton picker spindles[149] and Walton & Lonsbury[150] explained a system of determining *prices for hard chromium plating in a job shop*, based on a tank-hour rate. Dubpernell & Martin patented an *improved barrel*[151] which, if practical, will offer great economies to the plater of small parts.

Solutions received their share of attention also. Paulson & Saunders described the use of an ion-exchanger for *removing contaminating cations* from

chromium baths[152] and Balbierz & Burgess[153] compared the usual sulfate solution with the *fluoride bath*, indicating that the latter has the advantages of better throwing power and higher cathode efficiency. Patents included *addition of indium* to the common sulfate bath, claimed by Hackerman[154] and a specified wetting agent to retard liberation of chromic acid fumes, claimed by Chester.[155] A chromium solution containing *strontium sulfate and potassium fluosilicate* as catalysts was patented by Stareck.[156]

Other Metals

Copper plating was covered by five patents but only one article, by Rama Char & Shivaraman[157] who obtained *bright deposits from an alkaline copper oxalate-monoethanolamine bath*. Patents to Pierce[158] on a *brightener* for acid copper baths and to Jernstedt & Patrick on one for cyanide baths[159] covered this subject. Improvement in metal distribution in acid copper plating by superimposing an *asymmetric a.c.* on the direct current was claimed in a patent granted to Chester.[160] *Immersion deposits* were treated in two patents, one to Culverhouse[161] for *adherent films on zincated aluminum* involving a copper fluoborate bath, and the other to Berman & Katz[162] for *films on iron and zinc involving zinc* plating first from a solution containing a minute amount of lead and cadmium.

Tin received only a moderate amount of attention during the year. Discher[163] studied some *properties of stannous sulfate* baths and their role in tin plating, Andrews patented the addition of *dihydroxydiphenyl sulfones* to acid bath,[164] Buser[165] produced a machine for *continuously plating strip* in an acid fluoride bath, and Smith developed a *flow brightening process* for electrolytic tin plate which consisted of cooling in a gaseous atmosphere without solidification, followed by a quench in warm water.[166] A bit of interesting research by Bryan[167] on simple *chemical displacement films of tin on aluminum* produced a solution containing stannous chloride, rochelle salt and caustic soda, while Heiman[168] patented a solution for the same purpose, consisting of tin salt, fluoride, glue and an hydroxyaromatic compound.

In the field of cadmium and zinc plating, Menzel described some of the *troubles experienced with zinc*[169] and identified the causes, while Ottens compared *zinc and cadmium* from a practical point of view.[170] In an original research employing the *fluoborate baths*, Anantharaman & Balachandra studied the optimum conditions for deposition of *cadmium*[171] *and zinc*.[172] The former was found to be slightly inferior to the cyanide bath in throwing power and conductivity but superior in other respects. The latter was found to be comparable to the cyanide solution, was stable and easily controlled and had the important advantage of being non-poisonous. Patents consisted of claims by Chester for superimposing an *asymmatric a.c.*[173] to improve metal distribution in acid zinc baths, and for lignin sulfonate, molasses and trifluoracetic acid for *brightening acid zinc baths*,[174] while Wean[175] claimed that *addition of minor amounts of titanium* to the acid bath would produce bright, ductile deposits of zinc.

In connection with other metal deposits, Wood commented on the mechanism of *brightening action of sulfur in silver plating solutions*[176] and the operation and maintenance of *sulfate type rhodium solutions* were detailed in a survey by Laister & Benham,[177] which included a discussion of the properties of the deposit. Rhodium was the subject of an article by Weisberg also,[178] who presented details on the *production of heavy deposits*. The author stated that the phosphate and the mixed phosphate-sulfate baths are unsuitable for such deposits but the sulfate bath can produce bright deposits up to 0.001 inch thick without cracks.

Alloys

Alloys containing tin received more attention than other alloy deposits. Deposition of various alloys was studied by Davies, Angles & Cuthbertson,[179] employing fluoborate and fluosilicate baths. The progress of their investigation was summarized with the comment that the *fluosilicate bath appears to show a great deal of promise*. A chloride-fluoride bath for depositing an *alloy of about 65% tin and 35% nickel*, which is bright and corrosion resistant was developed by Cuthbertson, Parkinson & Rooksby[180] and covered in a patent to Parkinson.[181]

Copper-tin alloys were treated in one article by Richter,[182] who described an immersion brass-colored deposit on steel from acid sulfate solutions, and in a patent to Faust & Hespenheide for an *alkaline cyanide-phosphate bath* capable of producing bright deposits.[183] Lewsey offered some observations[184] on the depositions of *tin-zinc alloys*, difficulties experienced and solution of some problems, while DuRose & Hutchinson investigated the influence of operating variables[185] on the composition of *tin-lead deposited from the fluoborate bath*. This paper also included tests on an electrolytic method for determining alloy composition.

Brass received very slighting treatment in the literature, total gleanings consisting of an experimental paper by Horiuchi[186] on the *growth of parallel grooves on soluble anodes* during electrolysis and a critical look at *white brass as a substitute for nickel plate* by Saltonstall.[187] Brittleness limits thickness to a maximum of only 0.0003″, which, in turn, limits the use of this deposit to indoor exposure, so that it does not appear to be a permanent substitute.

Patents included a fluoborate-tartrate bath for depositing *lead-antimony alloys*, granted to Hitchens & Owens,[188] a solution for cobalt and *cobalt-molybdenum alloys* claimed by Brenner & Burkhead,[189] alloys of tungsten with iron, cobalt and nickel from an alkaline bath, granted to Brenner, Burkhead & Sentel[190] and *alloys of phosphorus with nickel and cobalt* employing acid sulfate-chloride baths in the presence of phosphoric and phosphorus acids, claimed by Brenner, Couch & Williams.[191] A *diffusion alloy* produced on iron by deposition of a manganese alloy, followed by heating, was claimed to produce corrosion resistance by Nachtman.[192]

Metallizing — Vacuum and Vapor Processes

Electroforming and metallizing by chemical reduction of aqueous solutions exhibited very little activity and there were no developments of outstanding importance. The most notable application was by Bower-

man & Walton,[193] who produced *cloth-backed printed circuits* with unconnected sections by electroforming and stripping from a stainless steel base onto a cloth-backed adhesive tape. Brenner received a patent on a method for *electroforming gun barrels and liners* on a fusible metal coated form,[194] while Dean used a *base of titanium and zirconium*, the surface of which was passivated by exposure to air, in order to strip the deposit.[195]

Aqueous reduction, heat reduction and vacuum evaporation were discussed in an article by Heritage & Balmer[196] and patents were granted on a *spray metallizing apparatus* invented by Sargrove[197] and on the *addition of an anionic wetting agent* to the mixture of silver salt and reducer in the chemical reduction method, claimed by Drake.[198] *Metal powder films* were disclosed in a patent issued to Schwartz[199] on a vehicle consisting of gum mastic, rosin and balsam dissolved in chloroform.

In the recently quite popular field of *vacuum metallizing*, Cross compared the *economics of the process* with electroplating, pointing out that the former is to be considered mainly for very large production where the quality of the finish does not have to be high.[200] Aside from this, other articles in the technical literature were variations of the same subject, a description of the process and equipment. These were offered by Shepard,[201] Bancroft[202] but the latter also described the procedure on *plastic sheet in continuous lengths*.[203] Modifications in *metallizing equipment* were patented by Chadsey,[204] Chadsey, Clough & Godley,[205] and by Shapiro.[206]

Pack chromizing, which has some interesting applications, was covered in two descriptive articles by Burt[207] and Seelig[208] and *gas plating*, which involves decomposition of a volatile metal compound by heat in a closed chamber, was compared in one article with electroplating,[209] with emphasis on the *versatility of metal carbonyls*, but the patent literature indicated considerable activity in the latter process. To us, the most interesting of the patents was granted to Toulmin[210] who proposed *continuous casting and the use of the heat in the metal* to provide the temperature for decomposing the coating metal salt vapor. Other patents included a *machine for spraying metal carbonyl* onto the surface, claimed by Davis & Belitz,[211] a process for *plating cylindrical steel shafts* with nickel carbonyl, claimed by the same inventors[212] and *continuous gas plating* processes, one for *wire* granted to Fink & Bishop[213] and one to Toulmin[214] for *rolled sheet metal*. Other patents were granted to Davis & Belitz[215] and to Fink.[216] Specific coatings were claimed in two patents. Fischer suggested *coating iron with aluminum* by decomposing a mixture of gaseous hydrogen and aluminum chloride[217] and Fink claimed *adherent deposits on aluminum* using nickel carbonyl.[218]

Conversion Films — Corrosion Preventives

In the broad field of conversion coating, *phosphate processes* were most prominent in the literature. For the occasions when the film must be stripped for reprocessing, Eisler & Doss[219] found that the most effective solution consisted of *caustic and cyanide with a large amount of sequestering agent*. For zinc and iron phosphate films simple immersion at room temperature was found to be satisfactory but manganese phosphate films required elevated temperatures and cathodic treatment. Phosphates were also treated in an article by Brown[220] who discussed *performance and control* of the process and in one by Holden[221] who detailed the *different types of phosphate coatings* and their application in the fields of corroison prevention, wear prevention and cold-working lubrication. Two patents were granted, one on a phosphating solution containing an *organic nitro salt*, to Hyams & Nicholson,[222] and the other to Benzing[223] on the *use of ammonium chromate* instead of chromic acid in the final rinse.

Other types of conversion coating processes were covered only to a minor extent, even the popular *chromate conversion* treatment being responsible for only one patent to Chester[224] on a solution of chromic acid, ammonium persulfate and trifluoracetic acid, for zinc. *Sulfide processes* also accounted for only one patent, to Baxter[225] on treatment of iron with a solution of sulfide, sulfite, thiocyanate and a mineral acid.

Hydrocarbon and other *organic types of corrosion preventives* received no recognition in the technical press but accounted for a number of patents, to Rocchini,[226] Romberg,[227] Morway & Young,[228] Prutton,[229] Hanson & Nex,[230] Schiermeier & Jones,[231] Kopf & Westcott,[232] Dixon & Sproule,[233] Blair & Gross,[234] Zisman & Baker,[235] Mikeska[236] and Schiermeier & Poitz.[237]

Volatile corrosion inhibitors, also known as vapor phase inhibitors, are used mostly by impregnating paper and cloth packaging materials but should be included in this review for the sake of completeness since they are becoming an important factor in the prevention of corrosion of ferrous articles in shipment and storage. Patents on new chemicals and processes were granted to Wachter & Stillman,[238] to Scharr[239] and to Newschwander.[240]

Testing and Control

Cleaners, their choice and control, could very easily be considered the greatest problem of the metal finisher. A research project under the direction of Linford & Saubestre[241] compared the *sensitivities of various degreasing evaluation tests*, which indicated that the atomizer test is most sensitive. Other work published in the technical literature consisted of a *qualitative test for detergency* involving agitation of the soiled metal surface in detergent solutions, developed by Fineman[242] and a simple procedure for *screening metal cleaners* to determine optimum cleaning cycles, described by Miller & Hedman.[243] Work in the field of cleaners also included an *apparatus for testing efficiency of cleaning solutions*, patented by Tiers[244] and an *analytical procedure for total phosphates* in metal cleaning compounds suggested by Mankowich.[245]

Chemical analysis was the subject of a number of other papers. Hogaboom[246] described the early days of plating and the *beginnings of analytical control*. Two procedures were suggested by Gabrielson[247] for phosphating solutions, employing *ion-exchange* for metal and phosphate contents. *Polarigraphic* methods were employed by Diaz[248] for determining tin and lead in their solutions, and by Diaz & Lindemann for zinc in alkaline solutions.[249]

Parker described various *suitable procedures for*

gold solutions, including the alloying metals added for color.[250] Sulfate was determined in nickel solutions by Langford,[251] who preciptated it as barium sulfate and *titrated the excess barium with a sequestering agent*, a method suitable for routine control but not as accurate as the gravimetric method. It was found by Serfass, Freeman & Pritchard[252] that preciptation of the nickel with ferrocyanide prior to *determining the boric acid content of nickel plating solutions* improved the analysis. Analysis of minute amounts of toxic materials in plating room wastes was covered in two articles, one by Kruse & Mellon[253] on *cyanide and thiocyanate* using pyridine type reagents, and one by Serfass, Muraca & Gardner[254] on *cadmium*, both employing colorimeters for the analyses.

Concerning the deposit, Thon, Yang & Yang[255] analyzed the corrosion products as a method of measuring the *change in porosity as a result of corrosion*, while Opinsky, Thomson & Boegehold[256] used a slow humidity cycle, elevated temperature and superimposed dip of a weak electrolyte to rate the *corrosion of unprotected steels*. The anodic solution method for *testing thickness of deposit* was found very accurate by Waite.[257] According to Faraday's law, if the current and area are kept constant the thickness of deposit dissolved is a direct function of time, and a commercial apparatus has been based on this principle. Stripping of the recently developed *tin-nickel* deposits from copper and brass was determined by Britton & Michael[258] to be most effective in *hot concentrated phosphoric acid* and quantitative results were also obtained with reverse current in 10% hydrochloric acid at high current densities. For deposits on steel, the magnetic tester was found best. The authors also found that the usual ferrocyanide porosity test gave good results only if the samples were first cleaned cathodically. Lutwak also concerned himself with porosity and, in a very interesting study, developed a *new method for coatings on zinc-base die castings*, employing a test solution of ammonium chloride and potassium ferrocyanide.[259] The former corrodes the zinc at the bottom of the pores and the latter forms a white, insoluble compound with the dissolved zinc. A preliminary thin coat of shellac keeps the precipitate from spreading or migrating.

Apparatus described during the year included one for estimating *thickness of anodic films on aluminum*,[260] a new *electronic thickness gauge based on skin effect* and developed at the National Bureau of Standards by Brenner & Garcia-Rivera,[261] which is non-destructive and suitable for both magnetic and non-magnetic metals, if there is an appreciable difference in conductivity between base and deposit, and two patents, to Rudge on an apparatus for measuring thickness of *non-magnetic coatings on a magnetic base*,[262] and to Carroll & Miller[263] on an *X-ray device* for thickness of tin coatings on iron. A patent on an instrument for measuring *surface tension* of solutions was granted to Vonnegut.[264]

Other items of interest in the field of control and testing consisted of a description of the *slot type plating cell* for investigating variations in the plating process with current density, first employed by Mohler,[265] a description of various *types of commercial thickness testers* and their applications,[266] and two articles on the *statistical quality control* approach to plating solution control by Woodell[267] and by Pocock.[268]

Wastes — Treatment and Disposal

This subject, of ever-increasing importance to industry, received the attention expected in the technical literature but few new developments were patented during the year. *Ion Exchange* is the most recent method of handling the problem and was the subject of an A.E.S. research project, Walker & Zabban[269] studying the *removal of cyanide*. In this laboratory project regeneration efficiency of the resin and stability were not determined although this will be a determining factor in commercial application of the process. The economics of *chromic acid recovery from anodizing operations* was described by Armstrong[270] who presented operational cost figures, while one article assessed the position of *ion exchange processes in plating and allied industries*[271] and another, by Kressman[272] discussed materials for removal of metals and salts. Paulson[273] pointed out that in hard water districts it may be *cheaper to deionize and recirculate* waste water rather than to treat new water before use.

Descriptions of *operating installations* were presented by Hendel & Stewart,[274] Bourdoin,[275] McElhaney,[276] O'Connor[277] and Sundwick & Delos,[278] while Greer described the *instrumentation* in chromium waste treatment.[279]

Reduction of chromium waste was discussed by two authors, Channon claiming that *sulfur dioxide* has the advantage of a strongly acid reaction and higher reducing potential than other reducing agents[280] while Hodges[281] found that *sodium metabisulfiate* was easiest to handle and rapid in action. *Cyanide* was also discussed in two articles, one by Whitlock[282] on the significance and treatment, including *the chemistry of the processes* and one by Walker & Zabban[283] who pointed out that *ozone only oxidizes cyanide to cyanate*, ferrocyanide and ferricyanide are not decomposed and the reaction must be catalyzed to prevent excessive losses of ozone. The most pertinent suggestion of the year and one which should be considered carefully, is due to Hauri,[284] who pointed out the reduction in plating room wastes possible with the *use of reclaim tanks*.

Pickling wastes were surveyed in an article by DeLattre,[285] who detailed the technical and economical aspects of *continuous pickling lines* and available *spent-acid disposal methods*. This subject accounted for the only patents in the field of wastes. Tanski received one on the *treatment of acid pickling wastes with slaked lime*,[286] Nugey claimed a process[287] of *neutralization with caustic* to precipitate the iron, addition of lime to precipitate the sulfate and treatment with carbon dioxide to form soda ash, and Shaw recovered ferrous sulfate by evaporation followed by acid addition, thus *regenerating the pickle*.[288]

With respect to other pickling solutions, McCormack described *recovery of ferric chloride from muriatic acid pickling baths* by extraction with isopropyl ether, after oxidation,[289] and Mancke regenerated *nitric acid*

pickles by autoclaving to produce insoluble ferric salts and free nitric acid.[290]

Miscellaneous

A *theory of bright plating* was described by Hoar[291] and suggestions were made for practical advances based on this theory. Dubpernell & Dubpernell[292] studies of *hydrogen overvoltage* suggested that it is not due to hydrogen at all, but to deposit of minute traces of alkali metals such as sodium. A re-examination of the controversy over *potassium vs. sodium cyanide*[293] suggested that, although KCN permits more rapid plating, in a majority of cases price and availability are the controlling factors. Modjeska evaluated *carbonate removal methods*,[294] concluding that calcium hydroxide is the most efficient material, and Meyer, Muraca & Serfass[295] analyzed the factors leading to *decomposition of alkali cyanides*, their presentation including data for quantitatively evaluating the magnitude of the cyanide loss.

Other miscellaneous subjects which were not sufficiently prominent to warrant separate headings, included *water impurities* and their effect on plating solutions, surveyed by Smith,[296] a summary of recommended methods for *stripping deposits from rejects* by Leonard[297] and a *strip solution* consisting of alkaline cyanide plus a nitro-substituted aromatic compound patented by Springer & Meyer.[298] Also a *method for coloring iron, nickel, cobalt and manganese* in a fused caustic bath containing nitrate, claimed by Vordahl, Grace & Ecclestion[299] and a new *organic aluminum bath* comprising a metal hydride and aluminum chloride dissolved in a mixture of ethers, disclosed by Brenner & Couch.[300]

Common types of *anodes and their characteristics* were described by West,[301] including copper, cadmium, zinc and nickel but consideration was also given to some special points that apply to anodes in general. An *anode bag with a new type of closure* was patented by Hogaboom & Hall,[302] and *racks* were claimed by Schneider[303] and by Jones & Colby.[304]

In the case of other equipment, Brigham discussed the life *characteristics and aging of selenium rectifiers*[305] while Waeterman & Reinken covered their construction.[306] Colegate continued his series of articles on *filters and filtration practice*.[307] Patents included two on *plating barrels* of new design, granted to Lazaro[308] and Sommers,[309] a *plating tank made of attached sections* claimed by Messinger & Lytle[310] and a *pusher type automatic plating machine* disclosed by Davis.[311]

Bibliography

1. J. B. Campbell. Mater. & Meth., **38**, 119 (Nov.).
2. A. G. Gray. Metal Progress, **63**, 84 (Feb.).
3. F. J. Prescott, J. K. Shaw & J. Lilker. Metal Fin., **51**, 65 (Oct.).
4. E. A. Hedman & A. Miller. Metal Fin., **51**, 66 (Dec.).
5. H. H. Jones & R. C. White. U. S. Pat. 2,662,851 (Dec. 15).
6. L. Osipow, G. Segura, Jr., C. T. Snell & F. D. Snell. Ind. Eng. Chem., **45**, 2779.
7. J. A. Thomas. U. S. Pat. 2,653,883 (Sept. 29).
8. S. R. Dodd & E. J. Ainsley. U. S. Pat. 2,629,696 (Feb. 24).
9. C. Cone & J. Huebler. U. S. Pat. 2,625,495 (Jan. 13).
10. J. D. Rule. U. S. Pat. 2,651,311 (Sept. 8).
11. A. Kurt. U. S. Pat. 2,652,841 (Sept. 22).
12. E. F. Anderson. Prec. Met. Molding, **11**, 53 (Mar.).
13. G. D. Dill. Iron Age, **172**, 91 (Oct. 29).
14. G. T. Colegate. Sheet Met. Ind., **30**, 303.
15. N. Ransohoff. U. S. Pat. 2,632,980 (Mar. 31).
16. H. J. VanderWal. U. S. Pat. 2,624,982; 2,624,988 (Jan. 13).
17. L. H. Bishop & J. S. Finn. U. S. Pat. 2,637,948 (May 12).
18. R. S. Webster. U. S. Pat. 2,628,455 (Feb. 17).
19. F. Newell. U. S. Pat. 2,652,662 (Sept. 22).
20. R. R. Berg. U. S. Pat. 2,628,456 (Feb. 17).
21. G. Kroll. U. S. Pat. 2,628,457 (Feb. 17).
22. M. Sittig. Iron Age, **172**, 137 (Dec. 17).
23. A. E. Durkin. Mater. & Meth., **38**, 107 (Oct.).
24. M. A. Levesque. U. S. Pat. 2,626,224 (Jan. 20).
25. E. D. Dilling & G. L. Frederic. U. S. Pat. 2,653,134 (Sept. 22).
26. B. W. Floersch. U. S. Pat. 2,655,439 (Oct. 13).
27. M. Rosenfeld & C. F. Pickett. U. S. Pat. 2,631,950 (Mar. 17).
28. E. S. Criddle. U. S. Pat. 2,661,314 (Dec. 1).
29. J. T. Irwin. U. S. Pat. 2,636,009 (Apr. 21).
30. R. L. Sundberg, C. P. Albus & J. M. Cross. U. S. Pat. 2,649,415 (Aug. 18).
31. H. E. Morris. U. S. Pat. 2,657,217 (Oct. 27).
32. J. W. Carroll. U. S. Pat. 2,662,857 (Dec. 15).
33. R. O. Bailey. Metal Fin., **51**, 65 (Sept.).
34. M. H. Pakkala & F. J. Phillips. U. S. Pat. 2,641,559 (June 9).
35. R. Dunlevy, H. Frick & J. H. Shoemaker. U. S. Pat. 2,635,062-3 (Apr. 14).
36. I. C. Clingan. U. S. Pat. 2,655,481 (Oct. 13).
37. J. A. Faler. U. S. Pat. 2,635,064 (Apr. 14).
38. N. L. Evans. Iron & Steel, **26**, 134 (Apr.).
39. C. B. Francis. U. S. Pat. 2,630,393 (Mar. 3).
40. J. R. Swihart. U. S. Pat. 2,662,814 (Dec. 15).
41. J. F. Revilock. Steel, **133**, 84 (Dec. 21).
42. T. Dunnegan, Jr. & H. M. Ogle. U. S. Pat. 2,661,009 (Dec. 1).
43. L. T. Campbell. U. S. Pat. 2,650,599 (Sept. 1).
44. L. R. Howes. U. S. Pat. 2,650,603 (Sept. 1).
45. R. M. Drews & H. L. Farling. U. S. Pat. 2,653,115 (Sept. 22).
46. N. H. Brodell. U. S. Pat. 2,632,718 (Mar. 24).
47. R. Pottberg. U. S. Pat. 2,650,888 (Sept. 1).
48. E. E. Halls. Electroplating, **6**, 43.
49. C. J. Snyder & W. G. MacLelland. U. S. Pat. 2,643,961 (June 30).
50. H. Brenner. Electroplating, **6**, 371.
51. F. A. Lowenheim. U. S. Pat. 2,628,199 (Feb. 10).
52. W. L. Pinner. Plating, **40**, 1115.
53. E. F. Doyle. Metal Fin., **51**, 97 (June).
54. L. F. Spencer. Metal Fin., **51**, 70 (Mar.).
55. J. B. Miller. U. S. Pat. 2,624,661 (Jan. 6).
56. H. A. Stier. U. S. Pat. 2,642,348 (June 16).
57. L. W. Smith. U. S. Pat. 2,658,312 (Nov. 10).
58. J. J. Durnan. Iron Age, **171**, 133 (Feb. 12).
59. J. J. Durnan. Prec. Met. Molding, **11**, 51 (July).
60. A. Zimmerman. U. S. Pat. 2,648,176 (Aug. 11).
61. L. Kniep, Jr. U. S. Pat. 2,632,981 (Mar. 31).
62. F. E. Hendrickson. U. S. Pat. 2,624,158 (Jan. 6).
63. R. E. Brink. U. S. Pat. 2,646,654 (July 28).
64. C. H. Boehm. U. S. Pat. 2,641,872 (June 16).
65. W. G. Nuessle. U. S. Pat. 2,637,956 (May 12).
66. W. J. Cosmos. U. S. Pat. 2,639,560 (May 26).
67. R. O. Peterson. Iron Age, **171**, 134 (Mar. 19).
68. W. Bruckner. U. S. Pat. 2,633,206 (Mar. 31).
69. R. L. McIlvaine & J. L. Yates. U. S. Pat. 2,649,924 (Aug. 25).
70. S. F. Anderson. U. S. Pat. 2,641,877 (June 16).
71. J. N. Clyne. U. S. Pat. 2,637,147 (May 5).
72. F. E. Wing, Jr. U. S. Pat. 2,635,394 (Apr. 21).
73. C. A. Zinn & H. G. Perkins. U. S. Pat. 2,649,668 (Aug. 25).
74. C. C. Kinker & J. J. Murtach. U. S. Pat. Reiss. 23,715 (Sept. 29).
75. W. C. Burt. U. S. Pat. 2,660,007 (Nov. 24).

76. W. B. Knight. U. S. Pat. 2,636,319-20 (Apr. 28).
77. A. Hickling & J. K. Higgins. Trans. Inst. Met. Fin., **29**, No. 10.
78. J. Edwards. J. Electrochem. Soc., **100**, 223C (Aug.).
79. P. A. Charlesworth & C. Hobson. Sheet Met. Ind., **30**, 825.
80. S. Wernick & R. Pinner. Sheet Met. Ind., **30**, 571.
81. H. M. Freud. U. S. Pat. 2,647,865 (Aug. 4).
82. F. Sullivan. U. S. Pat. 2,661,330 (Dec. 1).
83. W. G. Axtell. U. S. Pat. 2,645,611 (July 14).
84. H. F. Walton. U. S. Pat. 2,645,635 (July 14).
85. R. Pinner. Electroplating, **6**, 360, 401.
86. V. Terhune. U. S. Pat. 2,657,981 (Nov. 3).
87. E. Shelton-Jones. U. S. Pat. 2,650,156 (Aug. 25).
88. F. H. Hesch. U. S. Pat. 2,640,806 (June 2).
89. W. C. Cochran. U. S. Pat. 2,650,157 (Aug. 25).
90. S. R. Prance & H. J. Reindl. U. S. Pat. 2,625,468 (Jan. 13).
91. W. G. Zelley. U. S. Pat. 2,638,410 (May 12).
92. C. W. Ostrander. U. S. Pat. 2,628,925 (Feb. 17).
93. A. W. Faucher. U. S. Pat. 2,634,224 (Apr. 7).
94. W. Stone. Iron Age, **172**, 104 (Oct. 1).
95. L. Marble. Metal Ind., **82**, 206, 244.
96. R. M. Terry. Prec. Met. Molding, **11**, 47 (Aug.).
97. G. T. Colegate. Sheet Met. Ind., **30**, 5.
98. K. G. Pinke. Prec. Met. Molding, **11**, 94 (Apr.).
99. H. L. Beaver. Prod. Fin., **18**, 46 (Nov.).
100. G. B. Ashmead. Metal Fin., **51**, 71 (Oct.).
101. H. C. Larson. Prod. Fin., **18**, 66 (Nov.).
102. J. Edwards & C. J. Swanson. Trans. Inst. Met. Fin., **29**, No. 5.
103. W. G. Zelley. U. S. Pat. 2,650,886 (Sept. 1).
104. K. L. VanderHorst. U. S. Pat. 2,650,901 (Sept. 1).
105. E. R. Calderon & G. W. Slomin. U. S. Pat. 2,654,701 (Oct. 6).
106. B. E. Bunce. Electroplating, **6**, 317.
107. R. Ore. Trans. Inst. Met. Fin., **29**.
108. R. J. McKay. U. S. Pat. 2,637,686 (May 5).
109. F. Keller, M. S. Hunter & D. L. Robinson. J. Electrochem. Soc., **100**, 411.
110. S. Tajima, Y. Kimura & T. Fukushima. Metal Fin., **51**, 69 (Sept.).
111. D. E. Saffel. U. S. Pat. 2,654,707 (Oct. 6).
112. R. B. Mason & W. C. Cochran. U. S. Pat 2,662,034 (Dec. 8).
113. H. K. DeLong. Trans. Inst. Met. Fin., **29**, No. 6; Met. Ind., **82**, 327.
114. H. K. DeLong. U. S. Pat. 2,654,702 (Oct. 6).
115. H. K. DeLong. U. S. Pat. 2,661,329 (Dec. 1).
116. W. F. Higgins. U. S. Pat. 2,650,902 (Sept. 1).
117. W. H. Colner, M. Feinleib & J. N. Reding. J. Electrochem Soc., **100**, 485.
118. J. G. Beach & C. L. Faust. J. Electrochem. Soc., **100**, 276.
119. W. C. Schickner, J. G. Beach & C. L. Faust. J. Electrochem. Soc., **100**, 289.
120. A. Korbelak. Plating, **40**, 1126.
121. H. J. West. Metal Fin., **51**, 68 (Sept.).
122. E. L. Gostin. Iron Age, **171**, 115 (June 11).
123. J. B. Campbell. Mater. & Meth., **37**, 96 (May).
124. P. Talmey & W. J. Crehan. U. S. Pat. 2,658,839 (Nov. 10).
125. G. Gutzeit & A. Krieg. U. S. Pat. 2,658,841 (Nov. 10).
126. G. Gutzeit & E. J. Ramirez. U. S. Pat. 2,658,842 (Nov. 10).
127. T. H. Bonn & D. C. Wendell, Jr. U. S. Pat. 2,644,787 (July 7).
128. D. R. Turner. J. Electrochem. Soc., **100**, 15.
129. A. E. Westman & F. A. Mohrnheim. Plating, **40**, 1366.
130. D. T. Ewing, J. K. Werner, A. A. Brouwer, C. J. Owen & W. O. Dow. Plating, **40**, 1391.
131. E. T. Richards. Metal Fin., **51**, 64 (Apr.); 60 (May).
132. G. Schore. Plating, **40**, 628.
133. B. C. Case. U. S. Pat. 2,654,705 (Oct. 6).
134. C. J. Swanson. Trans. Inst. Met. Fin., **29**, 91.
135. C. C. Roth & H. Leidheiser, Jr. J. Electrochem. Soc., **100**, 553.
136. J. F. Vogt & R. J. Herbert. U. S. Pat. 2,635,075 (Apr. 14).
137. A. H. DuRose. U. S. Pat. 2,635,076 (Apr. 14).
138. L. B. Portzer & W. C. Leitenberger. U. S. Pat. 2,637,687 (May 5).
139. W. J. Shenk, Jr. U. S. Pat. 2,644,788-9 (July 7).
140. H. Brown. U. S. Pat. 2,647,866 (Aug. 4); 2,648,628 (Aug. 11); 2,654,703 (Oct. 6).
141. H. G. Donnelly. U. S. Pat. 2,648,627 (Aug. 11).
142. H. Brown & L. B. High. U. S. Pat. 2,654,704 (Oct. 6).
143. J. D. Little. U. S. Pat. 2,658,867 (Nov. 10).
144. D. G. Ellis. U. S. Pat. 2,662,853 (Dec. 15).
145. M. F. Quaely. Plating, **40**, 982.
146. F. M. Burt. Metal Fin., **51**, 65 (Nov.).
147. E. A. Blount. Prod. Fin., **18**, 24 (Dec.).
148. G. M. Cabble, Jr. Metal Fin., **51**, 106 (June); 60 (July).
149. F. L. Bonem. Prod. Fin., **17**, 24 (Aug.).
150. W. F. Walton & P. B. Lonsbury. Plating, **40**, 1001.
151. G. Dubpernell & S. M. Martin. U. S. Pat. 2,624,728 (Jan. 6).
152. C. F. Paulson & G. H. Saunders. Plating, **40**, 1005.
153. R. A. Balbierz & H. D. Burgess. Iron Age, **172**, 126 (Oct. 22).
154. N. Hackerman. U. S. Pat. 2,630,407 (Mar. 3).
155. A. E. Chester. U. S. Pat. 2,655,471 (Oct. 13).
156. J. E. Stareck. U. S. Pat. 2,640,021-2 (May 26).
157. T. L. Rama Char & N. B. Shivaraman. J. Electrochem. Soc., **100**, 227.
158. W. J. Pierce. U. S. Pat. 2,663,684 (Dec. 22).
159. G. W. Jernstedt & J. D. Patrick. U. S. Pat. 2,636,850 (Apr. 28).
160. A. E. Chester. U. S. Pat. 2,651,609 (Sept. 8).
161. C. R. Culverhouse. U. S. Pat. 2,662,831 (Dec. 15).
162. H. Berman & S. Katz. U. S. Pat. 2,657,176 (Oct. 27).
163. C. A. Discher. J. Electrochem. Soc., **100**, 45.
164. J. W. Andrews. U. S. Pat. 2,633,450 (Mar. 31).
165. J. S. Buser. U. S. Pat. 2,648,625-6 (Aug. 11).
166. E. J. Smith. U. S. Pat. 2,661,328 (Dec. 1).
167. J. M. Bryan. Metal Ind., **83**, 461.
168. S. Heiman. U. S. Pat. 2,624,684 (Jan. 6).
169. T. J. Menzel. Plating, **40**, 364.
170. E. F. Ottens. Prod. Fin., **17**, 24 (Apr.).
171. T. R. Anantharaman & J. Balachandra. J. Electrochem. Soc., **100**, 232.
172. T. R. Anantharaman & J. Balachandra. J. Electrochem. Soc., **100**, 237.
173. A. E. Chester. U. S. Pat. 2,651,610 (Sept. 8).
174. A. E. Chester. U. S. Pat. 2,632,728 (Mar. 24).
175. R. J. Wean. U. S. Pat. 2,646,397 (July 21).
176. D. Wood. Metal Fin., **51**, 68 (Apr.).
177. E. H. Laister & R. R. Benham. Trans. Inst. Met. Fin., **29**.
178. A. M. Weisberg. Mater. & Meth., **37**, 86 (Mar.).
179. A. E. Davies, R. M. Angles & J. W. Cuthbertson. Trans. Inst. Met. Fin., **29**, No. 7.
180. J. W. Cuthbertson, N. Parkinson & H. P. Rooksby. J. Electrochem. Soc., **100**, 107.
181. N. Parkinson. U. S. Pat. 2,658,866 (Nov. 10).
182. H. W. Richter. Metal Fin., **51**, 66 (May).
183. C. L. Faust & W. G. Hespenheide. U. S. Pat. 2,658,032 (Nov. 3).
184. B. C. Lewsey. Electroplating, **6**, 411.
185. A. H. DuRose & D. M. Hutchinson. Plating, **40**, 470, 630.
186. T. B. Horiuchi. Metal Fin., **51**, 70 (Nov.).
187. R. B. Saltonstall. Mater. & Meth., **37**, 97 (Feb.).
188. A. L. Hitchens & R. G. Owens. U. S. Pat. 2,634,235 (Apr. 7).
189. A. Brenner & P. Burkhead. U. S. Pat. 2,653,127 (Sept. 22).
190. A. Brenner, P. S. Burkhead & C. A. Sentel. U. S. Pat. 2,653,128 (Sept. 22).
191. A. Brenner, D. E. Couch & E. K. Williams. U. S. Pat. 2,643,221 (June 23).
192. J. S. Nachtman. U. S. Pat. 2,637,896 (May 12).
193. E. R. Bowerman & R. F. Walton. Plating, **40**, 765.
194. A. Brenner. U. S. Pat. 2,636,849 (Apr. 28).

195. R. S. Dean. U. S. Pat. 2,646,396 (July 21).
196. R. J. Heritage & J. R. Balmer. Metallurgia, **47**, 171 (Apr.).
197. J. A. Sargrove. U. S. Pat. 2,631,565 (Mar. 17).
198. C. F. Drake. U. S. Pat. 2,639,997 (May 26).
199. M. Schwartz. U. S. Pat. 2,635,053 (Apr. 14).
200. I. Cross. Metal Fin., **51**, 59 (Dec.).
201. M. Shepard. Mater. & Meth., **37**, 97 (June).
202. G. H. Bancroft. Metal Progress, **64**, 87 (Sept.).
203. G. H. Bancroft. Modern Plastics, **31**, 122 (Dec.).
204. E. E. Chadsey, Jr. U. S. Pat. 2,635,579 (Apr. 21).
205. E. E. Chadsey, Jr., P. J. Clough & P. Godley, 2nd. U. S. Pat. 2,643,201 (June 23).
206. Z. M. Shapiro. U. S. Pat. 2,637,297-8 (May 5).
207. F. M. Burt. Metal Fin., **51**, 72 (Apr.).
208. R. P. Seelig. Mater. & Meth., **37**, 106 (May).
209. Anon. Steel, **133**, 120 (Oct. 19).
210. H. A. Toulmin, Jr. U. S. Pat. 2,657,457 (Nov. 3).
211. O. F. Davis & H. G. Belitz. U. S. Pat. 2,649,754 (Aug. 25).
212. H. G. Belitz & O. F. Davis. U. S. Pat. 2,631,948 (Mar. 17).
213. A. O. Fink & A. E. Bishop. U. S. Pat. 2,656,283 (Oct. 20).
214. H. A. Toulmin, Jr. U. S. Pat. 2,656,284 (Oct. 20).
215. O. F. Davis & H. G. Belitz. U. S. Pat. 2,638,423 (May 12).
216. A. O. Fink. U. S. Pat. 2,650,564 (Sept. 1).
217. J. Fischer. U. S. Pat. 2,643,959 (June 30).
218. A. O. Fink. U. S. Pat. 2,653,879 (Sept. 29).
219. S. L. Eisler & J. Doss. Metal Fin., **51**, 58 (Aug.).
220. R. J. Brown. Metal Ind., **82**, 125.
221. H. A. Holden. Metallurgia, **48**, 71 (Aug.).
222. M. Hyams & A. Nicholson. U. S. Pat. 2,657,156 (Oct. 27).
223. H. J. Benzing. U. S. Pat. 2,634,225 (Apr. 7).
224. A. E. Chester. U. S. Pat. 2,631,951 (Mar. 17).
225. J. E. Baxter. U. S. Pat. 2,644,774 (July 7).
226. A. G. Rocchini. U. S. Pat. 2,625,511 (Jan. 13).
227. J. W. Romberg. U. S. Pat. 2,627,474 (Feb. 3).
228. A. J. Morway & D. W. Young. U. S. Pat. 2,629,666 (Feb. 24).
229. C. F. Prutton. U. S. Pat. 2,629,676 (Feb. 24).
230. W. J. Hanson & R. W. Nex. U. S. Pat. 2,630,380 (Mar. 3).
231. K. F. Schiermeier & P. W. Jones. U. S. Pat. 2,632,709 (Mar. 24).
232. W. J. Kopf & L. C. Westcott. U. S. Pat. 2,634,237 (Apr. 7).
233. T. W. Dixon & L. W. Sproule. U. S. Pat. 2,637,703 (May 5).
234. C. M. Blair, Jr. & W. F. Gross. U. S. Pat. 2,640,029 (May 26).
235. W. A. Zisman & H. R. Baker. U. S. Pat. 2,647,839 (Aug. 4).
236. L. A. Mikeska. U. S. Pat. 2,659,705 (Nov. 17).
237. K. F. Schiermeier & H. A. Poitz. U. S. Pat. 2,661,296 (Dec. 1).
238. A. Wachter & N. Stillman. U. S. Pat. 2,629,649 (Feb. 24); 2,630,368 (Mar. 3); 2,643,177 (June 23).
239. C. H. Scharr. U. S. Pat. 2,653,854 (Sept. 29).
240. W. W. Newschwander. U. S. Pat. 2,662,808 (Dec. 15).
241. H. B. Linford & E. B. Saubestre. Plating, **40**, 379, 489, 633, 1269.
242. M. N. Fineman. ASTM Bull., No. 192, 49 (Sept.).
243. A. Miller & E. A. Hedman. ASTM Bull., No. 194, 51 (Dec.).
244. R. H. Tiers. U. S. Pat. 2,648,220 (Aug. 11).
245. A. M. Mankowich. ASTM Bull., No. 194, 51 (Dec.).
246. G. B. Hogaboom. Metal Fin., **51**, 93 (June).
247. G. Gabrielson. Metal Fin., **51**, 76 (Apr.); 63 (Nov.).
248. R. Diaz. Plating, **40**, 45, 260.
249. R. Diaz & E. H. Lindemann. Plating, **40**, 762.
250. E. A. Parker. Metal Fin., **51**, 56 (Sept.).
251. K. E. Langford. Electroplating, **6**, 41 (Feb.).
252. E. J. Serfass, R. B. Freeman & E. Pritchard. Plating, **40**, 59.
253. J. M. Kruse & M. G. Mellon. Anal. Chem., **25**, 446.
254. E. J. Serfass, R. F. Muraca & D. G. Gardner. Plating, **40**, 148.
255. N. Thon, L. Yang & S. Yang. Plating, **40**, 1011, 1135.
256. A. J. Opinsky, R. F. Thomson & A. L. Boegehold. ASTM Bull., 47 (Jan.).
257. C. F. Waite. Plating, **40**, 1245.
258. S. C. Britton & D. G. Michael. Trans. Inst. Met. Fin., **29**.
259. H. K. Lutwak. Trans. Inst. Met. Fin., **29**, 85.
260. Anon. Metal Ind., **82**, 11.
261. A. Brenner & J. Garcia-Rivera. Plating, **40**, 1238.
262. T. R. Rudge. U. S. Pat. 2,651,846 (Sept. 15).
263. K. G. Carroll & D. S. Miller. U. S. Pat. 2,642,537 (June 16).
264. B. Vonnegut. U. S. Pat. 2,627,177 (Feb. 3).
265. J. B. Mohler. Metal Ind., **83**, 219.
266. Anon. Electroplating, **6**, 249.
267. A. D. Woodell. Metal Fin., **51**, 54 (Dec.).
268. B. W. Pocock. Prod. Fin., **18**, 24 (Nov.).
269. C. A. Walker & W. Zabban. Plating, **40**, 165, 269.
270. D. T. Armstrong, Sewage & Ind. Wastes, **25**, 934.
271. Anon. Electroplating, **6**, 3.
272. T. R. Kressman. Sheet Met. Ind., **30**, 371.
273. C. F. Paulson. Metal Progress, **64**, 84 (Aug.).
274. F. J. Hendel & V. T. Stewart. Sewage & Ind. Wastes, **25**, 1323.
275. A. J. Bourdoin. Sewage & Ind. Wastes, **25**, 434.
276. H. W. McElhaney. Sewage & Ind. Wastes, **25**, 475.
277. S. F. O'Connor. Metal Fin., **51**, 56 (Feb.).
278. W. A. Sundwick & J. S. Delos. Sewage & Ind. Wastes, **25**, 44.
279. W. N. Greer. Sewage & Ind. Wastes, **25**, 930.
280. H. B. Channon. Sewage & Ind. Wastes, **25**, 923.
281. M. E. Hodges. Metal Fin., **51**, 60 (Oct.).
282. E. A. Whitlock. Electroplating, **6**, 325.
283. C. A. Walker & W. Zabban. Plating, **40**, 777.
284. C. F. Hauri. Sewage & Ind. Wastes, **25**, 586.
285. P. DeLattre. Sheet Met. Ind., **30**, 313, 365.
286. E. S. Tanski. U. S. Pat. 2,639,222 (May 19).
287. A. L. Nugey. U. S. Pat. 2,642,334 (June 16).
288. J. A. Shaw. U. S. Pat. 2,662,812 (Dec. 15).
289. R. H. McCormick. Metal Progress, **64**, 134 (Oct.).
290. E. B. Mancke. U. S. Pat. 2,643,204 (June 23).
291. T. P. Hoar. Trans. Inst. Met. Fin., **29**, No. 11.
292. G. Dubpernell & R. Dubpernell. Plating, **40**, 53, 151.
293. Anon. Electroplating, **6**, 197.
294. R. S. Modjeska. Plating, **40**, 1111.
295. W. R. Meyer, R. F. Muraca & E. J. Serfass. Plating, **40**, 1104.
296. J. B. Smith. Metal Fin., **51**, 69 (Feb.); 65 (Mar.).
297. C. D. Leonard. Electroplating, **6**, 290.
298. R. Springer & W. R. Meyer. U. S. Pat. 2,649,361 (Aug. 18).
299. M. B. Vordahl, R. H. Grace & P. H. Eccleston. U. S. Pat. 2,639,244 (May 19).
300. A. Brenner & D. E. Couch. U. S. Pat. 2,651,608 (Sept. 8).
301. A. C. West. Metal Fin., **51**, 66 (Aug.).
302. G. B. Hogaboom, Jr. & N. Hall. U. S. Pat. 2,633,452 (Mar. 31).
303. M. S. Schneider. U. S. Pat. 2,652,359 (Sept. 15).
304. H. F. Jones & H. R. Colby. U. S. Pat. 2,643,225 (June 23).
305. C. E. Brigham. Metal Fin., **51**, 56 (May).
306. F. A. Waeterman & L. W. Reinken. Plating, **40**, 254.
307. G. T. Colegate. Electroplating, **6**, 51, 85.
308. A. M. Lazaro. U. S. Pat. 2,640,025 (May 26).
309. C. J. Sommers. U. S. Pat. 2,642,392 (June 16).
310. W. Messinger & D. B. Lytle. U. S. Pat. 2,634,878 (Apr. 14).
311. J. V. Davis. U. S. Pat. 2,650,600 (Sept. 1).

Converting Polishing Lathes To Use Coated Abrasive Belts

By J. J. Durnan, *Behr-Manning Corp., Troy, N. Y.*

THE urgent need for simple but complete instructions on how to convert a polishing lathe from using set-up wheels to coated abrasive belts has become glaringly apparent. Reports from the increasing number of manufacturers in both metallic and non-metallic fields, telling of improved production and reduced cost in offhand grinding and polishing operations by replacing set-up wheels with abrasive belts, indicate the rapidly spreading interest this finishing medium has generated.

In answer to this need, the following conversion procedure has been detailed, which will insure good belt tracking, and a practical range of machine flexibility (changes in contact wheel sizes and belt lengths) on existing equipment. Time to make a conversion need not exceed one hour, and extra material — contact wheel, backstand idler and belt — will cost about $100. The improvement in operator comfort, speed of stock removal, quality of finish produced and rate of production possible will be apparent almost immediately and will soon cancel the cost of installation.

Selection of Equipment

New equipment required in the conversion includes a contact wheel (or belt back-up wheel), a backstand idler pulley and a coated abrasive belt. For recommendations on best polishing or grinding techniques an application engineer in the coated abrasive industry should be consulted. He can recommend specific belt speeds, grits, lubricants and contact wheel densities for a particular job. However, for test purposes the following general rules will suffice.

Contact wheels, usually manufactured of compressed canvas or rubber, are available in a wide range of densities (hardnesses). Hard density wheels permit a fast rate of stock removal while soft density wheels are used for producing fine finishes and contour work.

Belt selection depends on the results desired and the hardness of the material. For fast stock removal, coarse grit belts are required, and for finishing, fine grit belts. In general, 24 to 60 grit belts are recommended for rough grinding, 80 to 150 grit belts for intermediate polishing and 180 to 500 grit belts for finish polishing. Cloth-backed belts coated with aluminum oxide grains are preferred for metal. A grease lubricant is necessary for polishing aluminum and similar soft non-ferrous metals and will also improve finishes on steel.

Backstand idlers are the adjustable idler wheels that maintain belt tension and control belt tracking on the contact wheel. Several types of idlers incorporate a means of adjusting and controlling belt tension and tracking from the operator's normal working position.

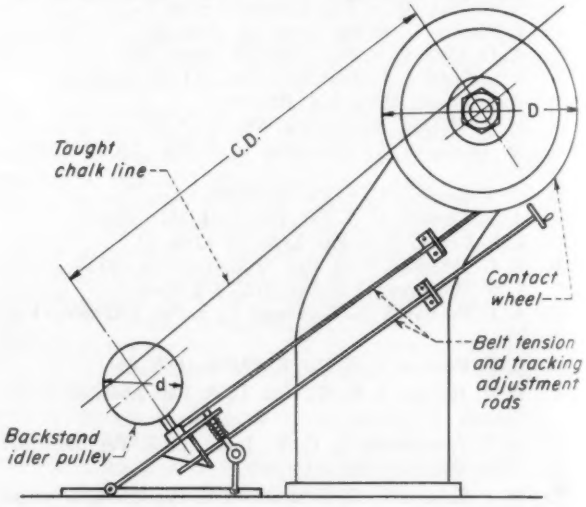


Fig. 1

Conversion Procedure

Below is outlined a six-step procedure for converting existing equipment to new coated abrasive belts. Preliminary preparations include removing the old set-up wheel, and checking the spindle for excessive runout and wear. If the spindle does not run true or is worn the contact wheel cannot run true. For best polishing results this contact wheel must run concentric.

Step 1:

Mount the new contact wheel on the spindle in its permanent position and tighten the spindle nut.

Step 2:

Calculate the center distance between the center of lathe spindle and the center of the idler pulley shaft using the following formula:

$$\text{Center distance (C. D.)} = \frac{\text{belt length}}{2} - \frac{(D + d)\,\pi}{4}$$

D = diameter of the contact wheel.
d = diameter of the idler pulley.

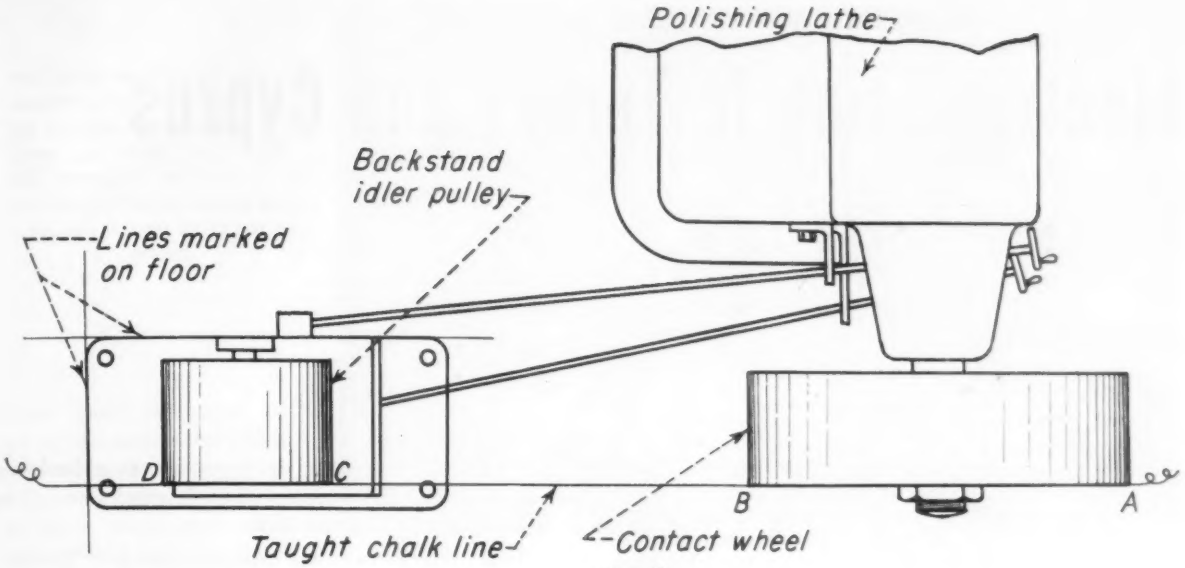


Fig. 2

Belts of standard lengths should be used where possible because they cost less and are more readily available than belts of special length. Install the Backstand Idler Pulley so coated abrasive belts of the following dimensions, which are stock design, can be used.

STANDARD BELT LENGTHS

Length	*Width*
48″	2½″
60″	2½″
118″	4″
132″	3″ & 4″
138″	3″ & 4″
148″	3″ & 4″
168″	3″ & 4″

Place the backstand idler on the floor behind the lathe in approximate alignment with the contact wheel and at calculated center distance as shown in Fig. 1. The belt tension adjustment on the idler unit should be adjusted to its center position.

Step 3:

Run a chalk line to the outside rim of the contact wheel and extend the line across the wheel to the idler pulley. The line will contact surfaces A, B, C, D, see Fig. 2. After aligning the edges of the pulley and the contact wheel with the taut line, mark the position of the backstand idler on the floor as indicated. When aligning the two wheels, the tracking adjustment must be placed at its center position to permit equal left and right side movement for belt tracking.

Step 4:

If the idler pulley is wider than the contact wheel, move the idler pulley assembly as shown in Fig. 3 a distance (T) equal to one half the difference in widths $\frac{w-W}{2}$. With the idler set in this position spot holes on the floor for fasteners.

(Concluded on page 69)

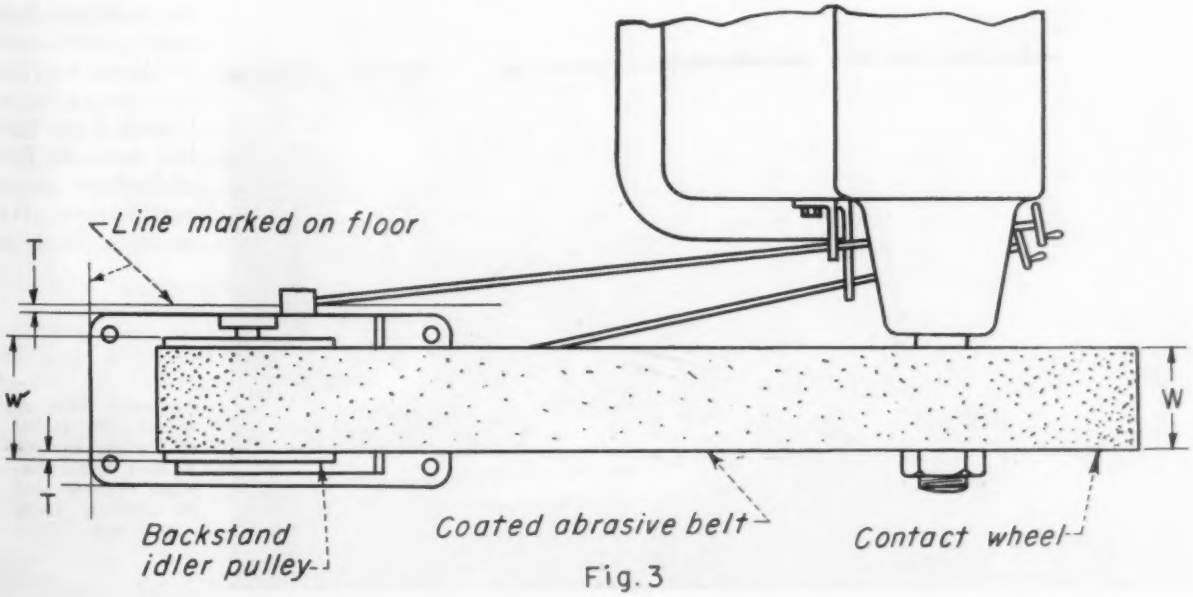


Fig. 3

Electroplating in Turkey and Cyprus

A Traveller's-Eye View

By Marvin Rubinstein,

Metal Finishing Consultant

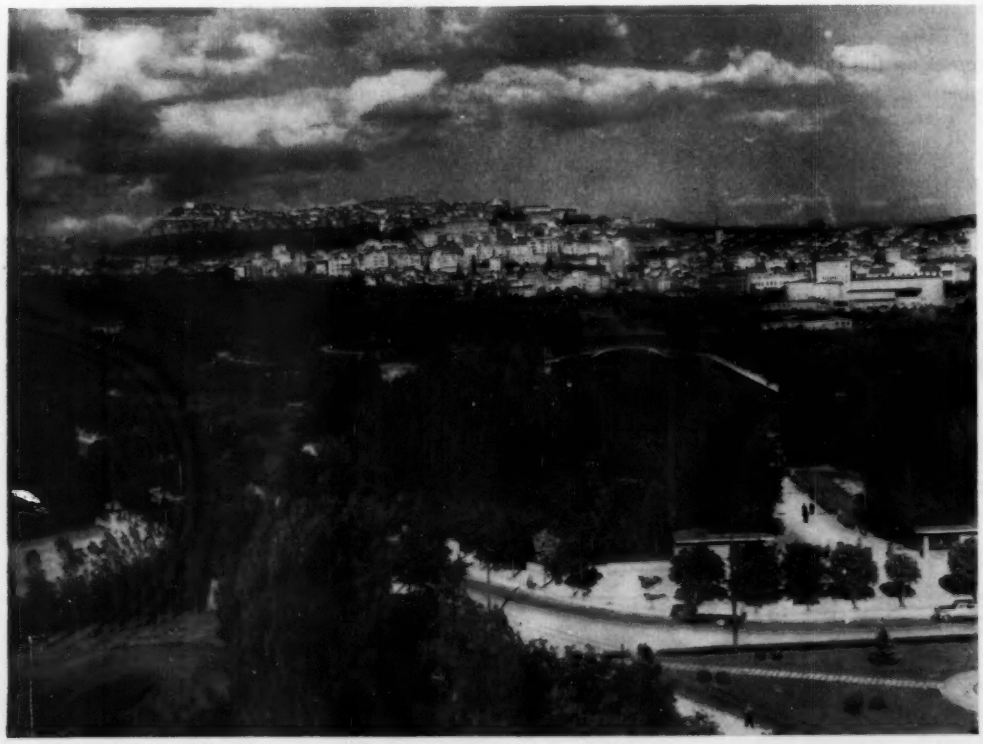
Before leaving the Middle East, Mr. Rubinstein visited two other countries: the big, dynamic republic of Turkey and the tiny, romantic island of Cyprus at the Eastern tip of the Mediterranean. In both places, he surveyed the metal finishing field. His observations are recorded here under the sub-title "A Traveller's-Eye View," which, he is careful to note "does not constitute a comprehensive survey" such as his previous article on Israel was. This article and those to follow (Greece, Yugoslavia, etc.) are more of an "estimate" based on talking to Chambers-of-Commerce heads, engineers, job shop owners, suppliers, and in some cases Government officials. Wherever possible, these talks were followed up by visits to a number of representative plants and shops. It should be kept in mind, however, that lack of time, language difficulties, certain security regulations, and the presence of the author's wife (who was always more interested in sight-seeing) prevented a thorough rechecking of all the material gathered. Apologies are proffered for any errors which may have crept in.

IN any discussion about Turkey (a country slightly larger than the State of Texas), one should always keep in mind that Modern Turkey did not exist until 1923. Until the revolt of the Young Turk Movement just prior to that time, the country was a backward, uneducated feudal regime, full of Oriental glamour and Oriental corruption and filth.

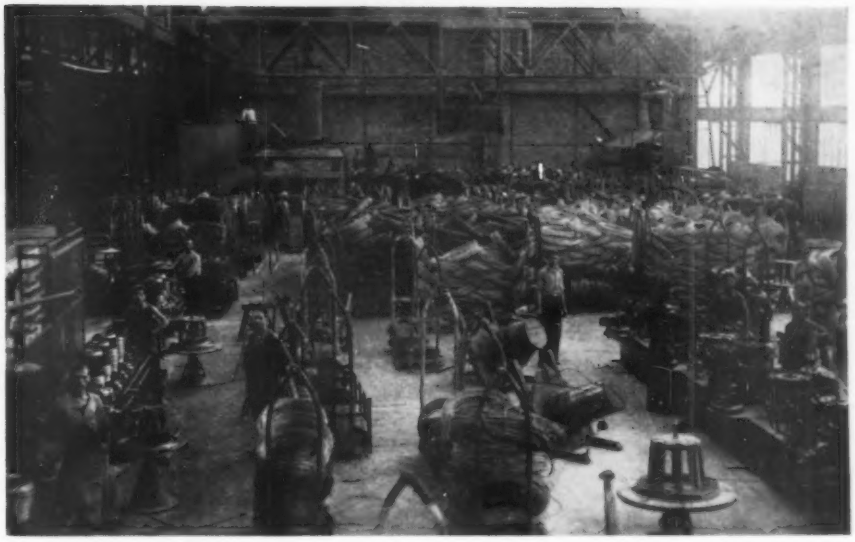
Today, the picture has radically changed. Turkey is now a modern country based on a Western pattern. If not exactly an England or a U.S.A., at least the directional signals are set and locked. With the single exception of little Israel, Turkey is the only Asiatic country in the Middle East with a rapidly developing industrial potential — already capable of a large turnout, but still growing.

The credit for this metamorphosis may be largely laid at the door of the leader of the Young Turk revolt, Mustafa Kemal Atatürk — a well beloved name in Turkey. Atatürk was that contradiction in terms, a "good" dictator, who never until the day of his death in 1938 allowed anything to stand in the way of his one dream, that of bringing Turkey back into the twentieth century.

And he did it. He modernized the language by changing it over to the Latin alphabet. He gave better education to Turkey's youth, made it compulsory until the age of 16, breathed life into her universities. He modernized the army; built roads, bridges, hospitals. He separated Church from State, laid down the basis of Turkey's present constitutional Democracy. Most im-



An aerial view of Ankara, the capital of Turkey, showing its more or less suburban character and its relatively young age.



Part of the plant of the large wire manufacturing concern "The Turkish Industrial and Economic Installation and Works, Ltd.," showing the annealing furnaces in the background. The galvanizing setting is just out of sight at the left foreground.

portant from the point of view of this article, he laid a hand on Turkey's then practically non-existent industries and proclaimed that 'this too shall be up-to-date.'

Number of Shops

Unfortunately, industry — like Rome — is not built in a day. What with lack of technical know-how in the early stages and, among other things, a very bad dollar shortage of late, the going has been much slower than Atatürk would have wished. Present day Turkey is still predominately agricultural, though the balance is shifting daily. Naturally, as in other developing areas, basic industries such as iron and cement must come first. Electroplating shops start arriving much, much later. Thus, the writer is informed by a supplier in Istanbul that, as late as 1937, barely half a dozen finishing shops were operating in Turkey. Today, there are roughly 100 such shops (plus about 25 more who do only polishing), an increase of 1600 percent in 16 years or approximately a 20 percent increase yearly. This should prove a good gauge of the pace of industrial development in Turkey.

For the purposes of this article, only shops of two or more workers having at least 75 amperes of current available and utilizing baths of 25 gallons or more are included. There are undoubtedly an additional number of smaller installations, particularly in the jewelry trade, but their exact number is elusive.

Most shops operate only two or three baths of an average capacity of 100 gallons. Probably the largest installations in the country have baths not much larger than 500 gallons; only two or three such shops exist. Most shops use generators of 150 amperes, unless chromium is being plated, in which case 250 to 300 amperes are used. It is doubtful whether more than one or two shops utilize current sources of over 1,000 amperes.

Geographical Distribution

In a country of 19 million inhabitants, somewhat less than 10 percent of the population and most of the industry is congregated in the three large cities, Istanbul (900,000 people), Izmir (310,000) and Ankara (240,000). As another gauge of Turkey's growth, it should be noted that as recently as 1940, Izmir had only 184,000 people and Ankara, 156,000.

Istanbul (formerly Constantinople) is Turkey's economic heart — a world metropolis; an internationally famous port, and a most unusual one in appearance; a tourist center, with many sights of incomparable interest; a major rail and airline junction; a bustling town full of industry, commerce, and finance. Amid these lesser (from the plater's point of view) elements, can be found about 55 plating shops, 10 galvanizing firms, and 15 to 20 shops doing only polishing. Roughly speaking, two thirds of Turkey's metal finishing industry is congregated there. This overcentralization is comparable to that of Israel and, in the writer's opinion, is typical of all newly developing industrial economies.

Izmir (formerly Smyrna) is Turkey's largest Asiatic port and the center of NATO. The view of this port and city from the summit of a nearby hill presents a stirring sight. A bristling commercial mart for the tobacco, fruit, oriental carpets and other products of the interior, Izmir has only recently started on the task of encouraging the development of local industry. A dozen plating shops — all job shops — can be found there.

Turkey's capital city, Ankara (formerly Angora) shows less industrial development, being a government seat and the commercial center of the country's interior. Consequently, despite its size, only five or six plating shops can be found there. Incidentally, with a University and Turkey's only opera house, Ankara offers its residents considerable cultural advantages. Being a new city, it also gives him top housing facilities. Both Izmir and Ankara have a certain comfortable, middle-class aura about them, similar to that found in many of America's medium sized cities, e.g. Rochester, N. Y.; Denver, Colo.; and Pasadena, Calif.

The remaining metal finishing shops in Turkey are distributed approximately as follows: five shops in the city of Brussa, three or four shops in Adana, and two in Kaserei. About ten more shops are scattered throughout the remainder of the country. Of the shops mentioned, seventy-five percent are job shops, while the rest constitute parts of manufacturing firms. With the exception of two or three government shops, all are privately owned.

Metals Plated

Most of the shops plate only copper and nickel, using almost without exception cold, proprietary solutions.

Part of the same wire manufacturing company, showing the semi-automatic hot-dip galvanizing unit in the left background, near the windows (which substitute for fume extractors).

Ten to fifteen shops do chromium plating as well. Only three or four of these heat their solutions, while only two have exhaust ventilators on their baths. Consequently, most chromium deposits are very thin and used only for "color." A dozen firms do silver and/or gold plating, almost all on a small scale and usually for repair of holloware or jewelry. Brass plating can be found in four or five shops. Two companies have tin baths.

Hot zinc galvanizing baths are run by twelve firms, while only one or two do hot tinning. Two shops do anodizing and dyeing of aluminum. As far as the writer has been able to determine, there is no lead, platinum, indium or rhodium plating in Turkey. Nor is any other alloy except brass plated. No firms do bright plating, electropolishing, plating on plastics or aluminum, porous chrome, or plating with periodic reverse current. Only two Government plants utilize zinc, cadmium, hard chrome, phosphating and chemical blackening of steel. Three firms do electroforming (on phonograph record masters, electrotypes and cloth printing dies). Barrel plating is at a minimum.

Some Representative Shops

Of the 75 or so job-plating shops in Turkey, the best developed and probably the largest is *Ganz Nikelaj Atölyesi* (Ganz Nickel Plating Workshop) in Istanbul. Its co-owner, Mr. Nuran, one of the best known platers in Turkey, also does some consultation on the side. The shop, relatively clean and orderly, has four plating baths — two nickels, a chromium and a copper.

Electrically heated and with an exhaust ventilator, the chromium tank draws its current from a separate generator of 500 Amps., 10 V. The copper bath holds 175 gallons, while the two nickels are 265 and 215 gallons respectively. A 315 Amp., 6 V. generator feeds these three baths. The nickel bath is heated — a rarity in Turkey — using electrical immersion heaters. In an adjoining room are several double-head polishing lathes. There is no filter pump, no laboratory.

A more representative "large" job shop visited had a 150 gallon cold nickel, a 175 gallon cold copper and a 110 gallon cold chromium without ventilation (and consequently a good supply of shop dirt as well). A generator of 250 Amps., 10 V. furnished current to these three baths. Usual work consists of tubular furniture, plumbing faucets, and various fittings. The oddest thing about this shop is its neighbors. Located in a large rambling building in an industrial section of Istanbul, it has five competing job shops in the same building and about ten more in the same block!

Among the manufacturing plants using plating can be found three cutlery and tableware manufacturers; two firms making cigarette lighters; three or four small concerns manufacturing tubular furniture; one company making chains; one stove factory; a wire manufacturer; a plant making pins and paper clips; and at least two companies making lamps, lighting fixtures and novelties.

The three tableware firms finish the bulk of their work in nickel rather than silver. Another nickel user for various trim parts is the stove manufacturing company *Lakir Tümre*. Both use only still baths, and all work is wired. No one uses racks in Turkey.

Of the three or four firms in the country using barrel plating, the two largest are *Ventura Mayorkas*" — chain manufacturers who brass plate their links and other chain parts — and the firm of *Irtleman* who do tin plating on paper clips, pins, etc. in large quantity batches. The only other company using tin — and also a unique installation for Turkey — is a large wire drawing outfit with an automatic wire plating unit, the one example of automatic plating in the country.

Setrak Vartanyan, the smaller of the two plants turning out cigarette lighters, uses a nickel bath and a copper bath, each of 135 gallon capacity. With a 150 ampere generator, they plate about 800 of their regular lighters and 35 deluxe models every day.

The only civilian anodizing and aluminum dyeing firm in the country is *Penhas ve Vakamiadis* in Istanbul. They are manufacturers of ash trays, novelties and lamps. Another sizable lamp and lighting fixture manufacturer in Istanbul is a company called *Platin Ar*. They do nickel, copper, silver, and oxidizing in baths averaging 65 gallons each.

Electroforming

Electroforming can be found in three shops. *Sahibinin Sesi* (English translation: His Master's Voice) does copper electroforming and nickel and chromium plating on 'masters' in their phonograph record manu-

facturing plant located in Yesilkoy, a suburb of Istanbul. The firm is associated with Columbia Records. *Mensucat Santral* (Central Weaving Co.) in Istanbul electroforms special dies for printing patterns on cloth. Cloth manufacturing, incidentally, is one of Turkey's biggest industries. A third Istanbul firm electroforms electrotyping cylinders for the trade.

Galvanizing

Largest of a number of hot-dip galvanizing shops in Turkey is *Iktisadi ve Sinai Tesitat ve Isltme Türk Anonim Sirkete*, which also seems to be the longest name in this article. It means "The Turkish Industrial and Economic Installation and Works, Ltd.," who are large scale manufacturers of barbed wire, annealed wire, and nails.

Their galvanizing setting, a "Kaiser" unit made in Germany, is 20 feet long by 26 inches wide by 26 inches deep, and holds about 20 tons of zinc. With this bath, using a semi-automatic set up (pickling is done separately) where excess zinc is squeezed off by rollers following dipping, roughly 8 tons of wire per day are galvanized. Wire diameters vary from $\frac{1}{16}$ inch to $\frac{1}{4}$ inch. There is another such installation in Turkey, of approximately the same size, which specializes in the galvanizing of sheets rather than wire.

Unfortunately, the writer was unable to visit what are probably the three largest and most modern plating shops in Turkey. The Turkish War Department maintains a large armaments department, including a finishing shop, in Aksehir, a town of 50,000 people, deep in the interior of the country. About 150 miles away, in Ankara, can be found a good sized Government aircraft repair depot. Finally, the Government also runs a repair workshop for railroad and autobus stock and equipment. This is in the city of Adabazar. It is believed that all three of these shops do zinc plating and hard chromium build-up. The writer has also been told that the railroad repair shop and the ordnance firm do blackening and/or phosphating of steel, while the aircraft depot does cadmium plating and anodizing. There no doubt exist one or two other small shops handling only military operations.

Methods are Primitive

Plating methods in Turkey are essentially primitive. As previously pointed out, all plating baths are operated cold. The writer doubts if there are half a dozen exceptions to this rule. Cleaning is often done with hot caustic, followed by a scrubbing down with pumice or whiting. Where electrocleaners are used, they are almost invariably cold, employing a mixture of caustic, soda ash and cyanide. Numbers of shops use a combined copper plating and cleaning bath. The writer has seen no trichlorethylene degreasers and little use of organic solvents. Rinsing baths are always too small, too few in number, and the same rinse is used after both acid and cyanide baths. Sawdust drying is the rule. Agitation is a rarity, and filter pumps are unheard of.

On the equipment side, the picture is similar. Tanks for nickel and copper plating are usually wood with asphalt linings. Steel tanks are used for chromium plating and often for cleaning. Lead linings for the chromium bath are the exception. Most tanks are locally made, often home made, i.e. in the plating shop itself. With three or four exceptions, the current is furnished by a generator rather than a rectifier. In either case, the power source is imported. Where heating is used, it is either direct or by means of simple electrical immersion heaters. The writer has seen only two shops where agitators are being used.

Supplies and Services

Almost all equipment and chemicals are imported. Some tanks, a few polishing lathe stands, and polishing buffs are the major exceptions. Despite the fact that Turkey has large resources of chrome salts, zinc, manganese, antimony, copper, borax, emery, asphalt, and some gold and silver, most of these are too impure for direct use. These materials are exported and the purified salts and metals brought back in. As far as plating chemicals are concerned, the vast bulk of nickel, cop-

Entrance to Famagusta Old Town.

per, and silver salts as well as some electrocleaners are imported in the form of proprietary salts.

Biggest and practically only supplier in Turkey for the above materials and equipment is a large German firm whose agent maintains an office in Istanbul. In Turkey they have a virtual monopoly on furnishing "mixed" salts, polishing compounds, generators and other finishing equipment. Their foremost competitor is a British firm which does a relatively small business among the general run of plating shops in Turkey but does, however, help supply the War Department and Government sector with finishing materials. U. S. supplies can only be found in some Government shops and in one or two firms with American affiliates. Otherwise, they are virtually unknown.

As could be foretold from the methods used, bath control in Turkey is almost entirely rule-of-thumb. If any analytical tools are used, they are the hydrometer and pH papers. It might be sufficient to comment that when a really serious problem arises with one of the German company's solutions, a sample is sent to *Germany* for analysis! There is no plating and servicing or even part-time analytical service in the private sector of Turkish plating. More important, there does not seem to be a great demand for one.

A Conclusion and a Moral

Metal finishing has a great potential in Turkey. The interest is there, the focal points for further development are there, and the need for more and better finishing is increasing. True, compared to Israel (which itself is backward by U. S. standards), Turkey with ten times the population has only an equivalent number of shops, and those somewhat less modern. On the other hand, compared to her Arab neighbors or to most Asiatic countries, she is doing very well. What is needed there is a push.

Cyprus is famed for many kinds of lace wihch is worked by nearly all the women of Lefkara.

In the writer's opinion — and this goes equally for Israel, Greece, and a number of other countries even as far West as France — this push should be provided by the firms which sell the plater his supplies. Several times on his journey, the writer has asked supply agents, "I know that your firm markets bright nickel and other up-to-date processes. Why are they not being used here?" The answer has always been the same — that the customer doesn't want them, won't go to the trouble of controlling them.

If he may be permitted to editorialize, the writer feels that the customer "doesn't want them" simply because the supplier has failed to convince him of the advantages and the need. As for control, a wide awake supplier is always in a position to assist and instruct. The writer knows only too well the inertia from some of the 'old timers' that one comes up against (in Turkey as everywhere else). Progress is always slow, but the progressive attitude must come first; defeatism never modernized a plating shop.

Electroplating on the Island of Cyprus

Cyprus is a tiny island in the Eastern Mediterranean, about 40 miles south of the underbelly of Turkey. You could fit 80 Cypruses into the area of Turkey and twice Cyprus' population into Istanbul and in each case have plenty of room left over. Ethnologically, most of its population are Greek — in language, custom, and sympathy as well as by heredity — though, in fact, the Island is a British Crown Colony and military base in the Middle East.

For such an insignificant place, Cyprus has had a turbulent history. It has been overrun successively by the Phoenicians, Greeks, Assyrians, Persians, Ptolemaic Empire, Roman Empire, Byzantine Empire, Saracens, English, Lusignan Dynasty, Genoese, Venetians, and Turks before reaching its present status. Today, it is a thriving, prosperous little trading center and a wonderful vacation paradise for the small number of tourists lucky enough to have chanced upon it. It has good roads, pleasant hotels, interesting sights, ruins and antiquities. There are good beaches and small boat harbors for the Summer and skiing resorts for the winter. The people are friendly, and the prices are very low. What more can one ask?

Though of late the Cyprus Chamber of Commerce has been trying to increase industry there, the industrial story is still a short story. The electroplating story is a very short story. Biggest industry is probably mining, which includes copper, chrome salts, asbestos, gypsum, and some silver. It is interesting to note that the name 'Cyprus' originally was 'Kypros,' the Greek version of 'Cuprum,' which is the Roman name for 'copper.' Ancient Cyprus was famous for its copper and copper work. Other industries include a good sized artificial teeth factory (the sister company of one in Israel), lace manufacturing, and a variety of craftwork particularly on silverware and copper.

Largest Plater

After a rather thorough search, the writer was able to find only three plating shops of any size. A big first among these, and the only manufacturing concern of the three, is the firm of *Takis* in Nicosia, the capital of

Cyprus. Takis manufactures door knobs, handles, bathroom fixtures and the like from both brass and steel; plates them with nickel. Mr. Christodoulou, the owner, also operates a sawmill and a nail factory in the same building.

This plating shop occupies roughly 375 square feet, has a combined copper bath and cleaner (400 gallons) and a nickel bath of the same size. Both baths are fed by a 100 Amp., 6 V. generator; both have rheostat controls. The tanks, locally made, are asphalt-lined steel and have wooden covers. Both baths are run cold. The nickel bath is a proprietary solution; the owner was very secretive about the formula of the combined copper and cleaning bath. In an adjoining room of equal area are two 3 H.P. double-head polishing lathes.

A typical part is plated as follows: 1. Polish; 2. Soak and wipe in benzine; 3. Dry in sawdust; 4. Clean and copper plate, 30 seconds; 5. Nickel plate, 20 to 30 minutes; 6. Dry in sawdust (usually without rinsing); 7. Polish. All work, as well as the anodes, are held on wires. This installation, incidentally the most modern in Cyprus, is only four years old. The owner has plans for expanding it by adding a 400 gallon proprietary zinc plating bath to do work for the British Army. By the time this article goes to press, it will probably be in operation.

Other Shops

Cyprus' second shop is the firm of *Theodotou Brothers* in the village of Saint Domedios. In a room adjoining their home, they operate an 80 gallon proprietary cold nickel bath on a job basis. They also do immersion gilding. Smallest of the three firms is that of *Yacoubian* in Nicosia. They do job silver plating, also in part of their home. Their bath is fifteen gallons, using six volt batteries as a current source! Most of their work is on repairing automobile light reflectors.

This just about completes the list except for a number of tiny places, who do immersion gilding on jewelry. There is no other silver plating on jewelry, tableware, etc. simply because silver is so plentiful that only sterling is found on the market. A possibility exists that the British Army has a small plating shop there, but if so they keep it well hidden.

Plating methods used, as has been demonstrated, are relatively primitive. They are similar to those used on the Greek mainland, which methods will be described in the writer's next article on Greece. All supplies and chemicals are purchased from a British firm, usually through their agent in Athens. And that, for Cyprus, is just about all.

CONVERTING POLISHING LATHES

(*Concluded from page 63*)

Figure 4. Mounting a coated abrasive belt on back stand idler. The spring loaded idler assembly maintains belt tension. A handle on the idler bracket permits manual compression of the spring to shorten the center distance between the wheels for installing the belt.

Step 5:

Remove the idler unit and drill holes for expansion shields or other fasteners appropriate for securing the unit in position.

Step 6:

Bolt the unit in position, place the coated abrasive belt over the contact wheel and idler pulley. Adjust tension and tracking controls.

Many times operating conditions dictate that the backstand idler pulley be placed either on a wall behind the polishing lathe or even on the ceiling. Regardless of idler position, modifications of this procedure can be adopted to specific requirements of a particular installation.

A new coated abrasive belt polishing conversion in a metal finishing department will soon convince the user of its practicality.

Plating on Aluminum

The Phosphoric Acid Anodizing Pretreatment

By Bernard E. Bunce

ALUMINUM and its alloys which finish mechanically and electrolytically to a bright silvery surface of high reflectivity have generally been used without electroplating with other metals. At the present time, however, there is an increasing need for satisfactory methods of electroplating these metals. Nickel, chromium, brass, zinc, copper, gold, silver and rhodium plate, as well as oxidized electrodeposits are in demand. This change in emphasis in the finishing of aluminum has been created both because aluminum is becoming increasingly plentiful and economical to use and because of past experiences with other metals in such matters as replacement, marketing, customer trends, and sales appeal. Industry must be in a position, for some applications, to finish aluminum to match other metals. This is especially so under the present restrictions in the use of certain metals and their alloys.

One object in electroplating aluminum is to change color or appearance. Generally there is little increase in the resistance to corrosion as a result of plating, although some protection is afforded in certain cases. Resistance to abrasion or wear can be increased by hard chrome plating, and any tendency toward "smudging" may be eliminated. Other objectives in electroplating aluminum are to facilitate soft soldering, to improve electrical contacts, and to permit direct rubber bonding. Furthermore, protection under some types of service conditions, such as salt atmospheres, can be obtained with zinc and cadmium deposits. Nickel-chromium deposits offer some protection to aluminum in alkaline media.

Aluminum and its alloys do not respond satisfactorily to ordinary electroplating techniques. The lack of adhesion of most electrodeposits on aluminum surfaces is due to the presence of the natural oxide film as well as its high electrode potential. Numerous methods for the electroplating of aluminum have been suggested. Some of these procedures have established themselves in industry while others are often quite impracticable.

In the first category, the best, which include the pretreatment etching dips, the sodium zincate immersion method, zinc plating, and the anodizing surface treatment with and without subsequent modification, have been developed to meet commercial needs in the quality of the bond between deposit and base metal.

The Process

In order to obtain a successful electrodeposit, it has generally been considered necessary to secure first a clean, oxide-free surface on the base metal; the oxide film normally found on aluminum has been considered an important factor in the difficulties encountered during the electroplating of this metal. Certain types of anodic coating, however, have been found to function satisfactorily as a surface for electroplating. The fact that the anodic coating is extremely adherent to the metal surface and is quite porous would appear to explain this performance. Direct electroplating onto the anodic layer can follow in some cases whereas in others, further chemical treatment is necessary.

Two methods have chiefly been employed for plating on top of anodic coatings: (a) the process which makes use of a.c. oxalic acid coatings modified by immersion in ¼-1% hydrofluoric acid and (b) phosphoric acid processes, of which several variations have been described, including the Elytal process (Ginsberg, *Aluminium*, 1936, 18, 441—2) which established itself in Germany. These methods usually required modification of the coating by a short alkaline cathodic treatment, though the same result was sometimes obtained during the initial stages of, *e.g.*, cyanide copper plating.

Based on early work in this field, the Aluminum Co. of America developed a process using, *e.g.*, for 3S, aluminum-manganese (1.25%) alloy, 354 g./l. phosphoric acid, at 90°F., and 12 amp./sq. ft., using a treatment time of 10 minutes, and found that both copper and nickel, *e.g.*, from a pH 3.7 semi-bright cobalt-type bath, could be plated directly without modification, provided the anodizing conditions were closely adhered to.

However, the process of direct plating following anodizing, appears to have been largely neglected and it is the aim in this article to show the possibilities and advantages of this method when used on a production basis, over the better known and well-tried methods.

The Effect of Operating Conditions

Based on the phosphoric acid anodizing processes described, work has been carried out on several different alloys, and the optimum conditions established under production conditions for anodizing, followed by bright nickel, copper and silver plating. The results are summarized in Table I.

The first deposits on the anodic coating are dark or black in color irrespective of the metal plated. This may be seen if a speciment is examined after a few seconds of plating. The metal in the coating would appear to be very finely divided and may be present as fine fibres extending through some of the pores in the anodic layer.

It has been found possible to apply nickel, copper, cadmium, and silver directly over the oxide film. However, there is a danger that highly alkaline solu-

Reprinted from Electroplating.

Table 1.

Phosphoric Acid Anodizing Conditions

Applicable to the Treatment of Small Articles Prior to

Alloy	H_3PO_4 g./l.	Time (min.)	Temp. °F.	C.D. amp./sq.ft.	Approx. Volt.
(a) NICKEL PLATING					
B.S. S1C	500	10	90	12	20
B.S. NS3	350	10	90	12	24
B.S. 6L1	350	15	74	18	26
D.T.D. 634	350	10	90	12	20
	500	10	95	28	22
D.T.D. 443	350	10	90	12—18	18
Castings					
B.S. L33	350	10	90	15	20
B.S. LM 18M	350	15	90	12	15
D.T.D. 272	350	15	90	12	10
(b) PYROPHOSPHATE COPPER PLATING					
B.S. S1C	350	10	90	12	26
B.S. NS3	350	10	90	15	25
D.T.D. 273	350	15	74	18	26
B.S. 6L1	350	15	74	18	26
D.T.D. 634	350	15	90	18	34
Castings					
B.S. LM 18M	250	15	90	12	28
D.T.D. 298	350	15	80	18	20
D.T.D. 272	250	15	80	12	15
(c) SILVER PLATING					
B.S. S1C	350	10	80	12	28
B.S. NS3	350	10	80	12	30
D.T.D. 273	350	15	70	14	35
D.T.D. 634	350	10	80	12	32
D.T.D. 443	350	10	90	12—18	18

tions will attack the oxide film before it becomes covered with the electro-deposited metal. This is true in the case of hot cyanide copper solutions, and in order to electroplate copper, brass or other metals from strongly alkaline solutions it is necessary to obtain an undercoat of copper from a pyrophosphate solution.

Sensitivity to relatively small changes in the composition of the aluminum alloy to be plated is an important factor in the phosphoric acid anodizing process. This is especially so in any metal finishing procedure involving the use of bright nickel plating. It would appear that the presence of a small amount of alloying metal, which does not form an oxide under the anodizing conditions, is necessary to improve the conductivity of the anodic layer resulting in improved covering power of the plated metal and giving a minimum of interference with the bright plating mechanism of the bath.

It has been found that as the metal purity increases above that of commercial aluminum (99.0-99.3% Al), it becomes less susceptible to the anodizing treatment and more difficult to plate. The application of the phosphoric acid anodizing treatment has not proved very successful in the case of the usual die casting alloys, but one such alloy, L33 (Si 11-12%) has lent itself to direct bright nickel plating when used for relatively small and simply shaped parts.

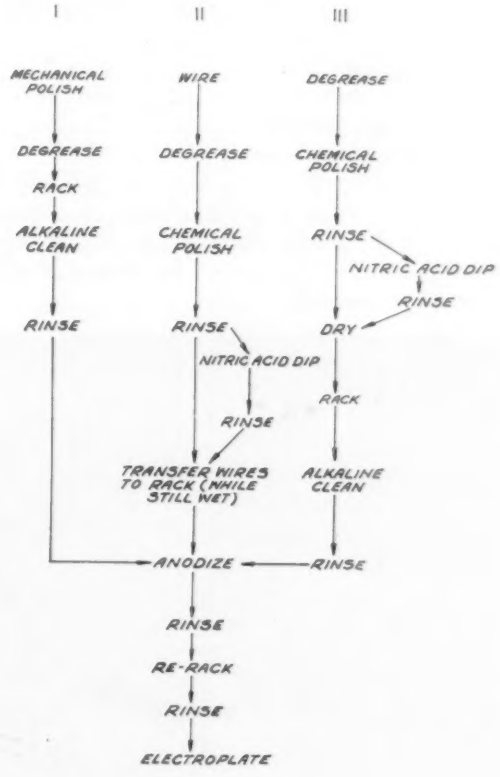
Work having large surface areas or very irregular surfaces is sometimes difficult to electroplate; this is probably due to the high electrical resistance of the coating which reduces the initial curent density at normal voltages and hence the covering power at low current density areas. Rapid covering, before the coating is dissolved by the plating solution, is of course essential.

Tests on nickel-plated commercial aluminum to B.S. SIC and to B.S. NS4 have indicated that the bond strength of the deposit is of the order of the tensile strength of the base metal, *i.e.*, 10 tons per sq. in. for B.S. S1C and 20 tons per sq. in. for B.S. NS4. In these tests, the failure occurred in the base metal.

It may be said generally that high purity aluminum is difficult to plate by this process. Copper-aluminum alloys and some magnesium-aluminum alloys plate readily, but in certain cases with copper-aluminum alloys the bond may not be completely satisfactory for all purposes. B.S.6 L1 material has been successfully plated with copper and brass for rubber bonding where the highest bond strength is not paramount.

The Sequence of Operations

A typical flow sheet for the process as used in conjunction with both mechanical and chemical polishing is as follows:



POLISHING:

Mechanical polishing is the most suitable process to use when a very high standard of finish is required. However, a somewhat lower standard of finish may be obtained at a considerable saving in time and labor by chemical polishing. The articles may be treated

on racks or in bulk, *e.g.*, in stainless steel baskets, again depending on the degree of finish required. The process consists of immersing the articles in a solution of the following composition:

80% by volume phosphoric acid S.G. 1.700
15% by volume glacial acetic acid S.G. 1.05
5% by volume nitric acid S.G. 1.42
0.02 g./l. wetting agent (cetyl pyridinium bromide)

The time of immersion is from 2-5 minutes at 80-90°C. with mechanical agitation.

The only tank material so far found to be completely satisfactory for containing this solution is 18-8 stainless steel. Efficient fume extraction is essential due to the evolution of considerable amounts of obnoxious gases.

NITRIC ACID DIP:

This operation is necessary only in the case of articles manufactured from aluminum alloys containing copper as an alloying constituent. The copper tends to be left on the surface of the article after chemical polishing as a black film which is readily removed in concentrated nitric acid without any loss in finish.

CLEANING:

Trichlorethylene vapor and liquid degreasing has been found to be the most convenient method of removing oil, with an alkaline inhibited cleaner to remove the deposit sometimes left on the surface after trichlorethylene degreasing and to ensure that the aluminum surface will wet readily in the anodizing solution. A typical cleaner contains:

Caustic soda	10 g./l.
Sodium carbonate	15 "
Trisodium phosphate	15 "
Sodium metasilicate	2 "
Wetting agent	0.1% (vol.)

The surface of the aluminum must be uniformly clean so that the anodic film develops evenly. Appreciable roughening of the surface by etching is neither necessary nor desirable.

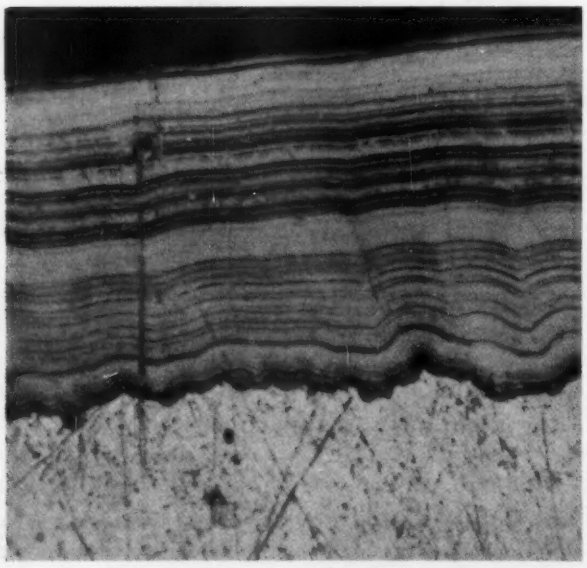


Figure 1. Section through nickel plated aluminum specimen showing laminated structure of bright electrodeposit and the anodic layer between the deposit and the base metal. X 2,000, but reduced by one-third for reproduction.

RACKING:

The racking of aluminum parts prior to anodizing in phosphoric acid and subsequent plating is carried out by the normal method used for anodizing. It is important to provide positive electrical contacts between rack and work, particularly during the anodic treatment. To ensure this, tension members are often used on the racks.

For the phosphoric acid anodic treatment, aluminum or alloy racks may be employed. These may be constructed in B.S. 6L1, B.S. 2L40, D.T.D. 443, or hardened commercial aluminum wire for the tension members, and B.S. S1C or B.S. NS3 for the spine. If frame type racks with screwed-in hooks for wire suspensions are employed, these may be stopped off with plastic coatings and bared only on the contact points.

Sequence II on the flow sheet is simplified to avoid drying and cleaning before anodizing. It is possible in cases where work can be chemically polished on wires and quickly and easily transferred to, *e.g.*, a frame-type rack.

The aluminum rack carrying the oxide-coated work may be used in the subsequent plating operations. However, before the rack is used again, the deposited metal and oxide coating must be completely removed by chemical or electrolytic stripping. Concentrated nitric acid is convenient for stripping the metal, and caustic soda or a phosphoric-chromic acid solution for removing the oxide coating. Because there is always the danger of an employee not completely stripping the rack before re-use, it is often preferred to use one rack (in aluminum) for anodizing and another (not necessarily in aluminum) for plating. The work must only be transferred from the aluminum rack to the plating rack with the aid of rubber gloves, keeping the work wet, otherwise smudging will occur.

RINSING:

Thorough rinsing to ensure cleanliness is as important when depositing metallic coatings on aluminum as when plating other metals. Careful consideration should be given to all water rinsing operations and adequate facilities provided.

Anodizing Technique

The phosphoric acid electrolyte may be prepared from a commercial grade of acid, specific gravity 1.700, 85% H_3PO_4. Dilution to the required concentration with deionized water is preferred, though water low in chloride and sulphate can be used. The concentration of acid need not necessarily be fixed for each aluminum alloy, for adjustment in operating conditions makes it possible for a fairly wide range of acid concentrations to be used. However, the most frequently used concentration is about 350 g./l. phosphoric acid. The optimum concentrations and operating conditions are given in Table I.

With a knowledge of the effect of the variables involved in the process, *i.e.*, acid concentration, temperature, time, current density A.C. or D.C., and degree of agitation, it is possible to adjust conditions to produce the desired type of anodic coating. If the acid concentration is increased, a decrease in coating density, *i.e.*, increase in porosity occurs. Similarly this is achieved

by increasing the temperature, decreasing current density and, under some conditions, increasing agitation. The build-up of the coating thickness varies approximately with time, and improved adhesion can occur with a change in the time of treatment.

The work should be made the anode in the electrolyte at a low voltage, the latter is then rapidly increased to a predetermined value. Control may also be carried out by the attainment of a predetermined current density. Since it has been found that the voltage and current density are dependent on the aluminum alloy used, it is not always practicable to process more than one alloy at a time. However, in certain circumstances an assembly may be constructed of two or more alloys and yet it may be possible for one set of anodic treatment conditions to produce the desired result.

Fairly vigorous agitation of the electrolyte is necessary to control the temperature at the anode surface. Uniformity of temperature ensures the production of an anodic film with uniform properties.

Periodic analysis of the phosphoric acid electrolye should be carried out in order to maintain the desired free H_3PO_4 content. A gradual build-up of aluminum takes place in the bath, but as long as the free acid is correct its effect is not pronounced. The presence of small amounts of other metals, due to dissolution of the alloying constituents, does not show a marked effect. The life of a solution cannot be predicted with certainty, but in the typical anodic procedure given for bright nickel plating, about 3.5 gm./l. aluminum can be tolerated before any plating difficulties occur.

The anodizing conditions presented in Table I are applicable generally to relatively small articles, such as safety razor parts. Larger work may require some variation in selected conditions.

Plating Procedure

When the correct type of anodic coating has been produced on the surface of the aluminum alloy, the subsequent plating procedure is the same as for other metals. Deposits can be applied from both alkaline and acid solutions with the exception of strongly alkaline hot plating solutions which attack the anodic coatings. Successful deposits on small parts have been obtained from silver, cadmium and zinc solutions, while large parts have been plated using an initial high current density strike. Rapid covering of the surface is advantageous in order to prevent attack on the anodic coating in alkaline solutions which may take place at very low current density areas.

Silver Plating:

The composition and operation of a typical silver bath suitable for the purpose are as follows:

Silver cyanide	35	gm./l.
Potassium cyanide	35	"
Potassium carbonate	40	"
Ammonium thiosulphate 60% solution	0.5	ml./l.

Temperature 70°F.
Current density 5-30 amp./sq. ft.

With vigorous agitation at 30 amp./sq. ft., a semi-bright silver deposit can be obtained on aluminum. It should be noted that since the anodic coating offers a considerable electrical resistance, this type of pretreatment should not be used where silver plating is required for electrical contacts.

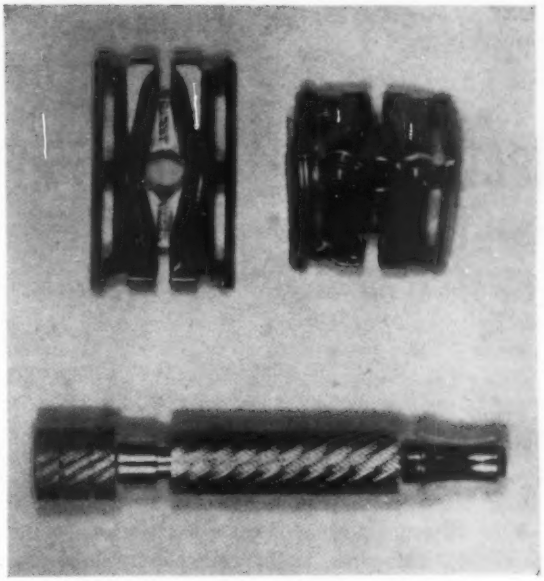


Figure 2. Aluminum alloy parts in D.T.D. 443 which have been bright nickel and rhodium plated following anodic oxidation in phosphoric acid solution. One part has been bent through 90° to show the excellent adhesion of the deposited metal after distortion (four-fifths actual size).

Copper Plating:

Copper from the pyrophosphate bath gives excellent results. This bath has the advantage of an operational pH near neutral and shows no attack on the anodic coating, while its throwing power matches that of the cyanide copper baths.

A typical pyrophosphate bath is as follows:

Copper pyrophosphate	100	g./l.
Potassium pyrophosphate	400	"
Ammonia S.G. 0.880	3	"
Citric acid	10	"

pH 8.5.
Temperature 120°F.
Current density 5-50 amp./sq. ft.

The acid copper bath can be used and the latest types offer possibilities for the production of bright copper deposits on aluminum.

Nickel Plating:

Nickel can be applied directly to the anodic coating from both dull and bright baths. Nickel plating is followed by chromium plating in the normal way.

During plating, the anodized surface should be covered rapidly with metal. If this does not occur, the anodic coating is probably insufficiently porous or it may be too thick. These deficiencies may possibly be overcome by reducing the anodic processing time, increasing the phosphoric acid content of the anodizing solution, or decreasing the current density during anodizing. Good covering in the plating solution but poor adhesion indicates that the anodic coating is too thin or too porous. Poor adhesion can also result if the anodic layer is allowed to remain dry for any length of time, or if the anodized parts are stored in water for more than about 15 minutes before plating, due to

(*Concluded on page 76*)

Electroforming Embossing and Graining Plates

By Elias Schore, *Supt. Plating & Grinding Dept., Neo Reviewer Printing Co., Weehawken, N. J.*

EMBOSSING plates made from skins of all animals, e. g. alligator, lizard, seal, etc., are being used by manufacturers in automobiles, handbags, leather goods of all types and in general for use on leather, leatherette, cardboard, cloth, and paper embossing.

Producing Embossing Plates

To prepare the skin for reproduction, the back must first be coated with an asphaltum varnish which is oil-free. The article must then be allowed to dry thoroughly. The skin is now ready to be prepared for copper deposition. A copper slab, 1″ wide on all sides (which is subsequently to be used as a margin) and $\frac{1}{16}$″ thick is used to support the skin. The skin itself is placed face upward in Ozokerite wax which has been warmed to approximately 140°F. Temperature is critical in that too hot a wax would deform or cause the grain to disappear. All edges of the skin are waxed to the slab covering as little an area of the skin as is possible but completely covering the margin on the slab. Ozokerite wax can be purchased in its pure form and needs no further treatment other than warming.

For very thin skins, instead of Ozokerite wax, a rubber cement made from gutta percha rubber, dissolved in one quart of either benzol or one ounce carbon tetrachloride, is used for supporting the skin to the slab. In all cases, the margin must be coated with Ozokerite wax.

For treating the skin itself the gutta percha cement is painted over evenly, as described above. A fine, flat, camel hair brush is used in this operation. Detail must not be lost by too heavy a varnishing of the skin. Allow it to dry completely. Ordinarily, this will dry in about one or two hours. The face of the skin is now ready for black-leading. Coat the face with "polishing" graphite, taking care to cover all the detailed areas with as fine a coat as possible. Follow this with a brushing of "moulding" graphite always taking care not to lose the detail. Finish the black-leading operation with another coat of the "polishing" graphite taking great care to cover but not fill all fine details and to secure the highest finish.

The contacts to the skin are applied by using $\frac{1}{16}$″ round copper set around the border of the skin itself and mounted by first painting with Ozokerite wax. The wire itself is contacted to the skin. To further insure immediate conductivity, paint the wire with a copper lining powder containing silver and taken up with a small amount of benzol in such a way that a paste is formed. Allow the contact wire to dry for approximately ½ hour.

To help immediate deposition of the copper in the solution, pour a solution of copper sulphate, prepared by using 10 ounces copper sulphate and ½ fluid ounce sulphuric acid to one gallon of water, over the face of the leaded skin and sprinkle the finest type of iron filings obtainable over the copper sulphate. Spray rinse thoroughly, and the skin is tready for reproduction.

Strike the plate in a regular acid copper bath using about 1½ volts and 10 amperes per square foot for about two hours. Remove the plate and inspect for complete coverage. Where the copper has not covered, touch the bare surface up with the copper lining powder described above, using all precautions not to coat already copper plated surfaces as this would cause a double plate. Return the slab to the copper plated bath and strike again for approximately ½ hour to cover all unworked parts. The current is now raised to 40 amperes per square foot so that the back of the plate does not become too rough. Agitation may be either by air, preferably, or moving cathode. A plating thickness of approximately 0.125″ is necessary. This will be produced in 60-65 hours. Remove the plate from the bath at this time, and separate the reproduction from the skin by using a blunt knife edge. Trim the edges on a hand saw and sweat the reproduction, which is negative and will reproduce positive skins, to a ½″ steel plate. Where necessary for large runs of reproductions, the original negative is used to prepare a matrix for further use.

Producing Graining Plates

The process already described is used in manufacturing embossed or varied articles. Graining plates

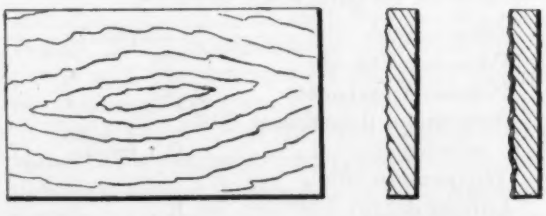
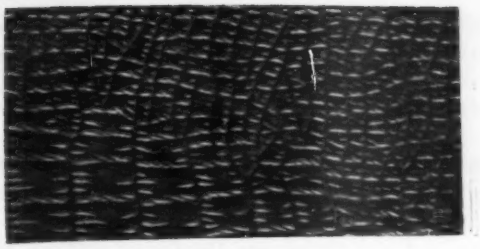


Fig. 1 Fig. 2 Fig. 3

Fig. 1. Shows original reproduction from a printing plate. Fig. 2. A section of Figure 1. Fig. 3. Illustrates the coating formed on the surface of the plate which carries the design.



Embossing Plate.

on the other hand will simulate wood or smooth surfaces and is accomplished by intaglio printing.

In the reproduction of graining plates, as fine a piece of wood is secured as is desired for the printed article. The wood must be sanded and planed to the smoothest finish that can be obtained. A photographic reproduction is made and the negative is retouched by an artist to further show detail. A positive print is made of the retouched negative.

The positive is printed to a sensitized carbon paper by using ultra-violet light, the paper being pressed to the print under vacuum. The carbon paper positive is now soaked in a solution of equal part of water and alcohol to soften it. A highly polished copper plate, the same dimensions of which are required for the finished printing plate, is set on a table and the carbon tissue is placed face down on its surface. The carbon tissue is pressed to the plate so that it will adhere well. The back of the paper is treated with warm water to remove the gelatin and paper from the surface of the plate. A resist is left on the face of the plate so that, when it is thinnest, the positive reproduction would have a more dense color printing and where it is barest the highest shades are obtained. The plate and resist are allowed to dry.

The plate is now made ready for the etching operation. The edges of the plate are protected with asphaltum varnish. Etching is done with solutions of ferric chloride ranging in strength of from 40-50° Baumé starting with the most concentrated since the more dilute solutions would tend to partially dissolve the resist.

After etching, the asphaltum varnish is removed with naphtha and the resist with acetic acid. The etched plate obtained is known as the master plate. A reproduction of this will produce the mother plate from which all subsequent graining plates will be made.

The etched plate described above is mounted on a suitable metal frame, and connecting wires are soldered to the plate on the back of the frame. The back and edges of the frame are coated with Ozokerite wax and allowed to dry. The plate is now faced with nickel of 0.0002". The purpose of the nickel facing, produced in a Watts bath, is to provide a stripping surface for the plate. To apply the stripping film to the nickel face, treat the nickel faced part in a 10% by weight caustic soda solution, at room temperature, anodically using a current density of 53-75 amperes per square foot for a few seconds until a brown color is apparent. The plate is rinsed thoroughly and transferred to another nickel until a plate 0.005" thick is obtained. Formulation of this nickel is as follows:

Single Nickel Plate	18	oz./gal.
Epsom Salt	1	"
Nickel Chloride	2	"
Boric Acid	1½	"

pH 5.6 - 5.8 colorimetric

The solution is brightened by use of acetic acid, and pH is likewise controlled by acetic acid. The operating temperature is 110-115°F. A Current Density 15-20 amperes per square foot is employed.

When the desired thickness of nickel is obtained, the plate is transferred to an acid copper bath and a backing of copper is plated to a thickness of about ⅛". This plate is known as the mother and reproductions similarly prepared will produce graining plates for printing.

The acid copper bath best suitable for electroforming is formulated as follows:

Copper Sulfate	30	oz./gal.
Sulfuric Acid (by weight)	10	"

Temperature 90°F. (plus or minus 5°)

A suitable nickel for electroforming is composed of:

Nickel Sulfate	10 oz.
Boric Acid	2 "
Ammonium Chloride	2 "
Sodium Sulfate	20 "

Important consideration for electroforming may be summarized as follows:

1. *Composition and properties of the anode*: They should be as pure as possible and bagged.
2. *Composition of the bath*: Control is necessary.
3. *Temperature of the bath*: Finest grain and smoothest deposit will be secured at temperatures outlined above.
4. *Cleanliness of the solution*: Filtration to remove insolubles from the anode and dirt brought into the bath is essential.
5. *Degree of agitation*: This will affect the grain of the deposit and, wherever possible, air is preferred to a moving cathode.
6. *Current density*: This also will determine stress and general conditions of the deposit.

The outline presented is a general study. Electroforming, however, is a positive science, and each article to be reproduced presents a problem in itself.

Photo-Galvanographic Plates

This process is over 80 years old. It was first used by the Austrian Military Geographic Institute in 1872. Because this method prints very fine and true reproductions, it is mostly adapted for such work as: portraits, book illustrations, oil paintings, water colors, wash drawings and photographs of nature. The main superiority of photo-galvanographic plate making lies in the fact that, instead of etching, the plate is electroformed directly from the gelatine positive.

After receiving the original model which may be a drawing, plaster cast, etc. the first operation is to make a photographic negative. The negative is the basis for all work to be done in preparing a good plate and

must be bright, crisp and not too dense. The negative is generally prepared larger than the desired size so that, after corrections are made, they will not be so obvious in the final proof. After drying the negative, all spots are carefully retouched. A positive, the same size as the proposed finished plate is now made. Autogravure tissue, which is a gelatine applied to paper, is now treated in a bichromating solution prepared by adding 14 ounces potassium bichromate and 2 ounces ammonia to five gallons of water. The solution should be filtered and kept at a temperature of 50°F. to keep the gelatine from melting. This is especially important in the summer when even the tissue is kept under refrigeration. The tissue is cut to size and placed into the sensitizing solution for from two to three minutes, until it is perfectly flat. It is then removed and laid on a ferrotype tin and squeezed, then placed in front of a fan to dry thoroughly. The object of the ferrotype plate is to supply a glossy finish to the paper which is now light sensitive. To print, the positive and paper are laid face to face in a vacuum printing frame and exposed to an arc lamp for from 20 to 25 minutes. While the print is being prepared, a copper plate is cleaned and silver plated in a conventional chloride-free silver cyanide bath for 15 minutes, rinsed and dried. The finished print is now laid on the silver plated surface and fastened on one end with adhesive paper. A rubber roller is now laid on the plate, while water is being poured on the plate so that the sheet will be squeezed to it. By doing this, the picture on the bichromate tissue is being transferred to the plate. The transfer is accomplished by developing in water heated to 100-120°F. After a few minutes in the hot water bath, the paper will show signs of blistering. The paper may now be removed by stripping from the silver plated surface and will leave the gelatine on the surface of the plate. In about 15 minutes, all surplus gelatine will be removed. The plate is now dried with alcohol and is ready for metallizing. The metallizing medium is French graphite as discussed previously. After finishing the graphite to a high lustre, it is placed in the acid copper solution and a very heavy shell is made. Plates are in the copper solution for approximately seven days. After sufficient deposition, the plate is removed and rubbed down with powdered engraver's charcoal. Details are brought out with roulette and burnishing tools. The plate is now ready for steel or hard chrome facing.

Steel Facing Process

The steel facing solution is prepared by first dissolving 100 pounds of ammonium chloride in 100 gallons of water. Iron plates are hung on the anode and cathode rods, making the cathode plate about one-fourth the size of the anode and a 6 volt current applied. Plates of Swedish iron are generally used in this process since, in practice, they have given best results. After forty-eight hours, the bath is ready to be used. To prepare a printing plate for steel facing, a wire is soldered to the plate. Usual mild immersion cleaning is done, finishing with a hand operation using whiting moistened with a five percent cyanide solution. After cleaning, all traces of the whiting are removed and the plate placed immediately into the facing bath. It is advisable that the current be on when the plate is placed into the bath. A current of three volts is used in the bath. In about 30 seconds, the plate will be covered with a silvery-appearing deposit of electrolytic iron. After ten minutes in the bath, the plate is removed. It will be noted that all brightness has disappeared. The plate is scrubbed with fine emery powder until the full lustre is restored and placed into the facing solution for another ten minutes. When the desired thickness of iron has been deposited on the plate, it is removed and washed thoroughly with water. The plate must now rapidly be dried, generally with absorbent rags and finally rubbed over with a thin film of oil to prevent rusting. A twenty minute plate will reproduce approximately 500,000 impressions. It is significant that there are but four shops in the United States doing this type of work. More recently, hard chromium deposits of approximately .00001-.00002" thickness are being used for facing these plates. The handling and stripping of plates prepared in this fashion have been of a definite advantage.

PLATING ON ALUMINUM

(*Concluded from page* 73)

partial hydration of the aluminum oxide which reduces the porosity.

Attack of the base metal through the pores in the oxide coating also appears to occur, resulting in the formation of small mounds of aluminum hydroxide on the surface, which give rise to discontinuities during subsequent plating.

Equipment

Cleaning and rinsing tanks are those generally in use in plating shops. The phosphoric acid anodizing tank should be rubber or polythene lined. Cooling coils may be in 18:8 stainless. Lead cathodes have been found to be quite suitable in service. Silica immersion heaters have proved successful in maintaining the temperature. Lead can, of course, be used throughout in which case the lead-lined tank and lead cooling and heating coils can serve as cathode. It should be pointed out, however, that lead is attacked slowly by the solution during periods when the tank is not in use. During operation, the lead deposits out in a spongy form which appears to have no detrimental effect on the process. Iron should not be present as it will be attacked and, in solution, will affect the anodic coating.

Agitation can be carried out by means of low pressure air bubbling, mechanical stirring, anode movement, or solution circulation. Pipes and equipment should be in rubber, polythene, lead, or stainless steel.

As is seen from Table I, the voltage supply required for anodizing varies both with the alloy and the metal to be deposited and a 40 volt motor generator or rectifier unit will meet the requirements of all alloys given. Alternating current proved successful in the limited instances in which it was tried out, *i.e.*, with alloys D.T.D. 634 and D.T.D. 443, but from the results obtained it would appear preferable to modify the operating conditions from those given here, which have been worked out for direct current.

Shop Problems

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Removing Soap Films

Question: We are attempting to improve the appearance of a certain line of steel hinges, which are copper plated, sulfided, wire brushed, and lacquered, by ball burnishing the copper plate. Can you give us a satisfactory method for removing the film of burnishing compound so that the sulfide coating will have good adhesion?

R. K.

Answer: Immersion in alkaline cleaner will remove the soap residues. Rinsing in hot water, then cold water should follow, after which the parts can be oxidized.

Plating on Plastics

Question: Would you venture an opinion as to the method of manufacturing the enclosed item?

C.H.K.

Answer: The sample forwarded is a typical example of metallized plastic, produced by silvering for conductivity, copper plating, ball burnishing and gold plating. You will find complete details on production of this type of coating in the latest edition of the METAL FINISHING Guidebook under the heading "Plating on Plastics."

Measuring Hardness of Gold Plate

Question: We do quite a bit of gold plating on a nickel plated base. We have two kinds of gold plate. One of these is a hard gold. Could you tell me the best way of testing our gold plate for hardness?

A. C.

Answer: Since such gold deposits are much too thin for the usual methods of testing hardness, namely by diamond pyramid indentation, abrasion tests would be the only procedures practicable. For comparative purposes, the amount of buffing required to remove the gold deposit can be employed as a measure of hardness. Other methods which are more reproducible are the Taber Abraser, which measures the number of revolutions of an abrasive disc or wheel required to penetrate the deposit under controlled pressure and speed, and dropping of abrasive grains from a long tube on the surface until the gold is worn away. On page 67 of the October 1952 issue of METAL FINISHING, will be found a photograph of a typical abrasion testing apparatus, as used by Tajima, Kimura and Fukushima to test anodized aluminum.

Hot Dipping Equipment

Question: We are anticipating putting in a hot tin-dipping and hot galvanizing plant in the building next door to our present location. Any information that you can give us as to the processes of hot tin-dipping will be appreciated.

One of the things we would like to know is how closely related they are. How much of the equipment we can use other than the two dipping pots? Specifically, what we are planning to do is to retin milk cans and general job shop work in galvanizing.

G. H. G.

Answer: We would suggest that you write to the Tin Research Institute, Inc., 492 West Sixth Avenue, Columbus 1, Ohio for literature on hot tinning.

If your cleaning, rinsing and pickling tanks, presently employed in the plating department, are sufficiently large to hold the work, your additional equipment will be a fluxing and hot dipping set-up plus a quench tank, if necessary.

Pickling Scaled Silver

Question: I would like to obtain a little information regarding the removing of silver oxide from silver, which has been porcelain enameled, in which the silver has been heated to 1225 degrees. I have tried dissolving the oxide in ammonium hydroxide; in fact, I left it in for twelve hours. It had no effect on it. I was under the impression that insoluble silver compounds dissolve in ammonium hydroxide.

It seems that only nitric acid will touch it but it etches the silver on the face too much and cannot be polished out because it is below the enamel surface. A potassium or sodium cyanide strip has a tendency to break the bond of the enamel to the silver. In fact, on the blue enamel an electro cleaner will cause the enamel to flake off, which makes it rather difficult to clean previous to nickel plating and gold plating.

J. D. T.

Answer: Ten per cent by volume sulfuric acid at 130 degrees F. should be used to remove the oxides. Then, if desired, a quick dip in nitric acid solution will produce a smooth matte but clean surface.

Hydrogen Embrittlement

Question: We have observed "stress cracks" in wrenches which have gone through the hot pickling bath prior to the chrome plating operation. It appears that "hydrogen embrittlement" is caused from this pickling operation. In order to correct this situation, it is necessary to subject the pieces to a temperature of 300 to 400° F. which permits the hydrogen to be driven from the surface, restoring the steel to its natural toughness. Can some changes in the pickling operation be made which would eliminate the

necessity of drawing the temperature?

G. L.

Answer: Use of an acid pickling inhibitor is the most effective way to minimize hydrogen embrittlement. These are obtainable from your local supply house. A list of inhibitor suppliers will be found on page 524 of the 1953 edition of the *Metal Finishing Guidebook-Directory*. The use of an inhibitor may eliminate the subsequent baking operation.

Mercury Dip for Instruments

Question: Please tell us how to make up a mercury cyanide dip for copper and brass parts to be used prior to silver plating. The problem to be overcome is lack of adhesion of the silver to musical instruments, such as trumpets, etc. The plating is part of a repairing and reconditioning process and lifting of the plate is most often encountered in the recesses where cleaning is difficult. It is thought that a mercury dip would show up these spots before plating.

W. J. M.

Answer: A standard mercury dip, known as a "Blue Dip" consists of:

	oz./gal.
Mercuric oxide	0.1
Sodium cyanide	4.0

Immersion for 2 or 3 seconds is customary on instruments. Mercury dips must be used with caution on brass, since there is a tendency to cause season cracking.

Aluminum Coating Steel

Question: In the July issue of *Metal Finishing* we note on page No. 92 reference to a "Mollerizing Process" for coating steel with aluminum. As our work consists of applying hot metallic coating we are interested in getting further information on this process and would like to know where we can reach the company for further information. Will you kindly advise us, for which please accept our thanks in advance.

K. L.

Answer: The latest address we have is:

American Mollerizing Corp.
901 North Westbourne Drive
Los Angeles 14, California

Stripping Bronze Deposits

Question: Can you furnish us with a procedure for stripping an alloy of 80% copper and 20% tin?

A. J. C.

Answer: The Tin Research Council has suggested the following formulas for speculum deposits (45% copper, 55% tin), which should also be suitable for deposits containing 80% copper and 20% tin:

1. Immerse at room temperature in:

	parts by volume
Water	150
Sulfuric acid	100
Nitric acid	8
Acetic acid	8

Stated to remove 0.0005" in 10-12 minutes from all base metals.

2. Reverse current at a temperature near boiling, using 6 volts:

	grams/Liter
Sodium hydroxide	10
Sodium cyanide	15

Rubber Deposition

Question: We are confronted with a problem involving electrodeposition of rubber and seem to recall the publication or announcement of this process. We would most sincerely appreciate being advised of the availability of any information regarding the method of depositing rubber by electrolysis.

V. H. P.

Answer: Some data on the process will be found in the following references: Monthly Rev., American Electroplaters' Society, Oct. 1935, Dec. 1937. These articles detail the formulas of the latex baths and the processing of articles.

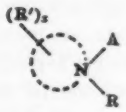
Recently Granted Patents
in the Metal Finishing Field

Patents

Bright Nickel

U. S. Patent 2,647,866. *Aug.* 4, 1953. *H. Brown, assignor to The Udylite Corp.*

A bath for the electrodeposition of bright nickel comprising an aqueous acidic solution of at least one nickel salt selected from the group consisting of nickel chloride and nickel sulfate, said bath also containing, in solution, not more than about 1.5% of at least one brightener selected from the group consisting of organic sulfonamides, sulfonimides, and sulfonic acids, and, in addition, about .003 to 0.15 gram per liter of a bath-soluble compound in accordance with the formula



where

represents a compound of the pyridine series selected from the group consisting of pyridine, quinoline, isoquinoline and C-methyl and ethyl homologues thereof, A is an anion of a water-soluble acid, R is an aliphatic radical containing from 1 to 4 carbon atoms, R′ is halogen selected from the group consisting of chlorine and bromine, and x is zero to 2.

Electrodeposition of Selenium

U. S. Patent 2,649,410. *Aug.* 18, 1953. *M. C. Bloom and J. P. Levy, assignors to Federal Telephone and Radio Corp.*

A process of regenerating acidic aqueous selenium dioxide electrolytic bath contaminated with organic matter which comprises adding thereto elemental selenium in the form of particles in a quantity greater than the normal metallic selenium content of said bath, which particles present a substantial total surface to contact with said bath and leaving the added selenium in the bath at approximately 100°C. for a period of twelve hours to six days until it absorbs said organic matter on the surfaces of said particles.

Electrodeposition of Selenium

U. S. Patent 2,649,409. *Aug.* 18, 1953. *A. von Hippel and M. C. Bloom, assignors to Federal Telephone and Radio Corp.*

The process for electrodepositing gray crystalline metallic selenium upon a surface of an article having a metallic surface from the group consisting of nickel, silver, antimony and steel, that comprises producing an initial coating of a selenide of said surface metal thereon, and then making the article the cathode in an electrolyte consisting of an aqueous solution of sulphuric acid having a concentration of about 18 normal, and having between 150 grams of selenium dioxide per liter and sufficient selenium dioxide to form a saturated solution dissolved therein, maintaining the temperature of said electrolyte between 55°C. and 120°C., and maintaining the current density between 8 amperes per square foot and 230 amperes per square foot.

Acid Pickling Inhibitor

U. S. Patent 2,649,415. *Aug.* 18, 1953. *R. L. Sundberg, C. P. Albus and J. M. Cross, assignors to General Aniline & Film Corp.*

A corrosion inhibiting composition for use in the treatment of metals with acid baths, which consists essentially of a substantially water-insoluble primary amine of the class consisting of aliphatic and alicyclic monoamines of 12 to 20 carbon atoms, and a nonionic dispersing agent of the class consisting of the poly-alkoxylated derivatives of aliphatic and alicyclic monocarboxy acids, of aliphatic and alicyclic monohydric alcohols and of alkylphenols, said acids, alcohols and alkylphenols having 12 to 24 carbon atoms, said derivatives thereof containing at least 4 oxyalkylene radicals and said oxyalkylene radicals each containing 2 to 3 carbon atoms, the weight ratio of said amine to said dispersing agent being substantially within the range of 1:1 to 1:9.

Carbonyl Plating

U. S. Patent 2,649,754. *Aug.* 25, 1953. *O. F. Davis and H. G. Belitz, assignors to The Commonwealth Engineering Co. of Ohio*

Apparatus for plating objects by gaseous metal deposition, said apparatus comprising an airtight chamber, a liquid atomizing means disposed in said chamber, said means including a nozzle comprising a tubular member through which liquid to be atomized is introduced into said chamber, said tubular member being surrounded by an outer tubular member having an opening in its outer end for discharging gas to propel a fine spray of liquid metal carbonyl into said chamber, means for supporting material in said chamber and spaced from said nozzle for positioning material to be plated at the extreme range of said spray, means for heating said material which is arranged behind a protective shield adjacent said material support and remote from said nozzle, a window section in a wall of said chamber for viewing the interior, an inlet to said chamber for introducing inert gas, and exhaust means including an outlet from said chamber for removing inert gas and decomposition products from the chamber.

Dust Collector

U. S. Patent 2,649,924. *Aug.* 25, 1953. *R. L. McIlvaine and J. L. Yates, assignors to Herbert Simpson Corp.*

A dust collector comprising a housing having an air inlet and an air outlet connection with an air passageway therebetween, a tray having a perforate bottom supported across said passageway, a plurality of contacting units disposed in superimposed relation in

said tray, each vessel including a plurality of small spheres supported on large spheres, means for maintaining a liquid bath around said contacting units at a constant level, and means for forcing air through said contacting units to the outlet connection.

Bright Dipping Aluminum

U. S. Patent 2,650,157. *Aug.* 25, 1953. *W. C. Cochran, assignor to Aluminum Co. of America*

The method of chemically brightening a surface of an aluminum article which comprises immersing said article in a solution having as the essential components thereof, on a weight basis referred to the total weight of phosphoric acid, nitric acid and water therein, about 73 to 83 per cent phosphoric acid, about 2 to 5 per cent nitric acid and about 14 to 23 per cent water, the solution being maintained at a temperature above about 70°C., wherein the specularity of the surface of the aluminum article is improved as determined from luminous apparent reflectance measurements obtained by use of a standard Hunter Multipurpose Reflectometer.

Bright Dipping Aluminum

U. S. Patent 2,650,156. *Aug.* 25, 1953. *E. Shelton-Jones, assignor to Aluminum Co. of America.*

A process for brightening metal from the group consisting of aluminum and alloys thereof which comprises immersing the metal in a bath having as the essential components thereof phosphoric acid of the formula H_3PO_4 and water, the water being present in a proportion to the phosphoric acid at least equal to that existing in phosphoric acid of about S. G. 1.72 (which contains about 87.5% by weight of phosphoric acid of the formula H_3PO_4 and about 12.5% by weight of water) and in a total amount up to that existing in a solution of phosphoric acid of about S. G. 1.72 and 20 per cent by volume of the solution of added water (which solution contains about 24% by weight of total water), at a temperature of at least about 80°C.

Gas Plating

U. S. Patent 2,650,564. *Sept.* 1, 1953. *A. O. Fink, assignor to The Commonwealth Engineering Co. of O.*

Apparatus for gaseous plating of work pieces at a high rate of deposition which comprises a chamber for containing the work to be plated, means for admitting and discharging heat-decomposable gaseous metal to said chamber, means comprising a fan for causing forced circulation of said gaseous material introduced into said chamber, said fan being arranged to force the gaseous material directly upon said work to be plated, means for heating said work to a temperature to cause said heat-decomposable gaseous metal coming in direct contact therewith to be decomposed depositing the metal constituent thereof, and means for cooling said heat-decomposable gaseous material, said cooling means being arranged in the path of the circulating gas and out of contact with said heated work to maintain said decomposable gaseous material at a temperature substantially below that at which the same decomposes.

Continuous Pickling Apparatus

U. S. Patent 2,650,599. *Sept.* 1, 1953. *L. T. Campbell, assignor to U. S. Steel Corp.*

In apparatus for the pickling of continuous metallic strip, the combination which includes a tank for containing the pickling solution, a non-revolving strip support located entirely within the confines of said tank above the solution level line, said non-revolving support comprising a cylindrical body and a square shaft, the outer surfaces

of said shaft and said cylindrical body being of a corrosion-resistant material, and shaft receiving recesses formed in the tank to engage said shaft and maintain the support in fixed position.

Plating on Aluminum

U. S. Patent 2,650,886. *Sept.* 1, 1953. *W. G. Zelley, assignor to Aluminum Co. of America.*

A process preparatory to electroplating an aluminum article which comprises immersing the article in a dilute zincate bath made up with about 16 to 150 grams per liter of both zinc salt and caustic alkali, the ratio of caustic alkali to zinc salts being about 5:1 to 15:1, at least one salt selected from the group consisting of soluble nitrates and soluble nitrites, the amount thereof being between about 0.25 and 2 grams per liter of the bath, and stripping the zinc deposit first formed in said alkaline zincate bath and again immersing the aluminum article therein prior to electroplating the same.

Roll Assembly for Continuous Strip Pickling Tanks

U. S. Patent 2,650,603. *Sept.* 1, 1953. *L. R. Howes, assignor to The B. F. Goodrich Co.*

An acid-resisting idler roll assembly for guiding and supporting strips of sheet material through an acid-pickling solution, said roll assembly comprising a shaft of acid-resisting material, a plurality of rolls consisting of yieldable resilient acid-resisting rubber-like material, each journaled for independent rotation on said shaft at positions longitudinally along said shaft providing a supporting surface, collars of acid-resisting material adjustably secured on said shaft and disposed at positions adjacent the ends of the roll assembly for limiting axial separating movement of said rolls, each of said rolls having a protruding separating portion at an end face providing a channel between the outer edge of each roll and the outer edge of the adjacent roll to permit movement of the material of said rolls into said channel upon radial compression, and the bearing portion of each of said rolls being capable of lubrication by said solution and formed with a series of alternating longitudinal roll bearing surfaces and solution conducting lubricating grooves in said rubber-like material.

Scale Removal

U. S. Patent 2,650,888. *Sept.* 1, 1953. *R. Pottberg, assignor to Freeport Sulphur Co.*

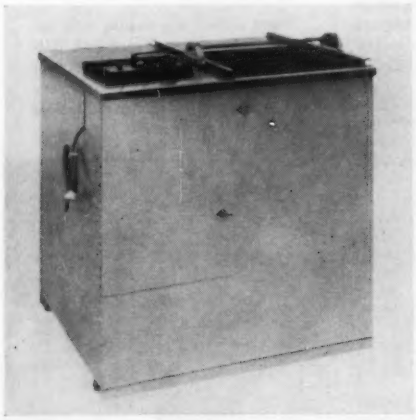
In the treatment of a metal article of sheet, plate or strip form having an adherent surface film of scale thereon, subjecting the scale-coated article at a temperature below that of scale formation to rolling pressure between opposite rollers having their axes in a plane normal to the article surfaces and intersecting them at substantially the area of contact of the rollers therewith, the diameter of at least one of said rollers being more than five times and less than fifty times the thickness of the strip, and forcing said rollers against the article surfaces under sufficient pressure to develop a ripple in the scale-carrying surface in advance of said rolling pressure contact, progressively disintegrating the said film of scale by said roller of limited diameter and preserving the disintegrated film in place on the article surface and simultaneously effecting a reduction of less than 10% in the thickness of the metal between the rollers, delivering the article with the disintegrated scale film adhering thereto, and subsequently treating the said adhering disintegrated scale film with a fluid reacting therewith to loosen and remove it.

Recent Developments

New Methods—Materials and Equipment for the Organic Finishing Industries

Small Volume Plating Unit

Sel-Rex Precious Metals, Inc., Dept. MF, 229 Main St., Belleville 9, N. J.



All of the necessary equipment for mass production plating of precious metals or small scale laboratory pilot plant operation is combined in the new portable Jet Plater. Also incorporated in the new unit is a unique "jet" agitation action, making it available for the first time in any small-volume plating unit.

Designed for high speed plating with the new Sel-Rex bright gold process and bright silver Sol-U-Salt bath, the plating unit is equally useful in the laboratory for pilot plant operation with any small-volume alkaline bath. The unit can be furnished with a rubber-lined or Koroseal tank for use with acid solutions and is ideally suited for still plating, or it can be fitted with a portable barrel for barrel plating operation.

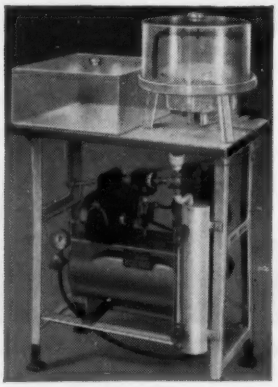
Completely automatic in operation, the unit consists of a Sel-Rex selenium rectifier with an automatic timer, of the proper output rating for the tank size; a stainless steel tank, which can be used as the anode, with a water compartment for temperature control; a movable work rack, which will accommodate a portable plating barrel; a corrosion resistant, stainless steel filter; a polyethylene, drip-proof pump powered with a ¼ h.p. motor; and a "safety" tank under the plating tank, pump and filter to catch leakage or accidental spillage.

Agitation is accomplished with a "jet" arrangement at the bottom of the tank which produces continuous rapid movement of the solution. The solution is continuously filtered and pumped back into the tank under pressure. Mechanical agitation, as well as motions to move the work, are eliminated.

Standard models have 10, 20, or 30 gallon capacity tanks. Larger units, up to 100 gallons, can be built to specification.

Lucite Salt Spray Tester

Belke Manufacturing Co., Dept. MF, 947 N. Cicero Ave., Chicago 51, Ill.



Convenient observation of salt spray corrosion tests is achieved through these machines with Lucite testing compartment and salt solution reservoir.

In operation the machine continuously subjects articles in the testing compartment to a salt spray fog at room temperature.

Designed for laboratory use, as well as for running small parts and samples, the machine is completely self-contained and attractively finished.

The salt spray testing compartment is approximately 13½" diameter x 8" high. The salt solution reservoir, approximately 15" x 16½" x 7". Compressor motor is ¼ HP, 115 V, 60 C, 1 Ph. Literature on request.

Immersion Tin

The Enequist Chem. Co., Inc., Dept. MF, 100 Varick Ave., Brooklyn 37, N. Y.

The above firm announces commercial availability of a fast depositing, white color, immersion tin process.

For those who require a corrosion resistant coating by a fast method without the use of current, this process answers a long sought need. It is operated at room temperature 75-85°F. in plastic, glass or stainless steel, tanks or crocks.

A uniform deposit is obtained in 2-3 minutes, with mild agitation.

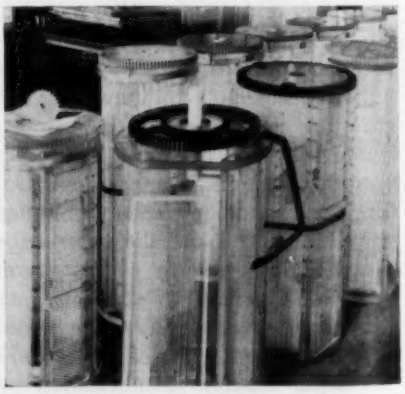
It is also applicable for anti-friction uses, electrotypers (eliminating tin-foil and tin electroplating) electronic parts, wire and sheets and a host of other products.

A fully equipped and recently enlarged laboratory is available for sample work and recommendations.

Replacement Cylinders for All Makes of Plating Barrels

The Singleton Co., Dept. MF, 5317 St. Clair Ave., Cleveland, O.

A complete line of replacement plating cylinders of "H-T Sincolite" to fit all makes of barrel superstructures, old and new, is now offered and is expected to save for platers the many thousands of dollars invested in their old and obsolete barrel superstructures which otherwise would be a total loss.



"H-T Sincolite" H-T Lucite and

Plexiglas, plating cylinders are said to be the only complete line engineered to fit perfectly in all the standard makes of plating barrel superstructures, and priced up to 22% less than other cylinders.

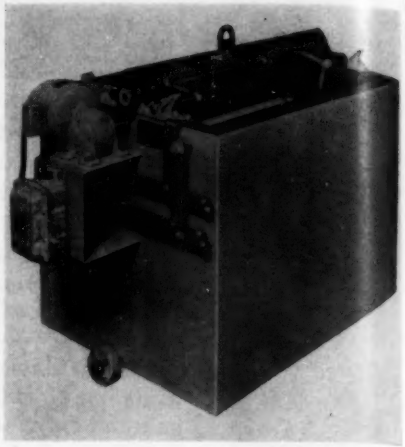
They consist of two heads, six heavy-rails and five panels — the only plating cylinders of their kind incorporating the exclusive heavy-ribbed, fusion-welded construction throughout (tensile strength of 10,000 p.s.i.). With no dangerous stresses from heating and bending, they hold their shape permanently without distortion in temperatures up to 200°F. The unique Singleton perforation pattern provides 17% more holes per sq. in. in panels for better, faster plating, yet it is structurally stronger. Included are all necessary installation accessories. A new bulletin RC-101 is available on request.

Improved Tank for Barrel Plating

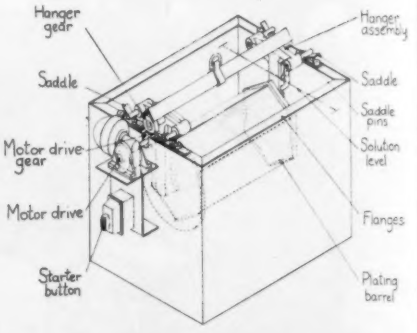
Hanson-Van Winkle-Munning Co. Dept. MF, Matawan, N. J.

The improved Mercil-type tank for barrel electroplating is designed to save space, reduce maintenance cost and simplify barrel-positioning. With the exception of chromium plating, any type of plating may be carried out in the new tank.

Key improvements: 1) Flanges have been turned in. This saves space and provides an enclosure for hanging heating or cooling coils. 2) Motor



drive has been made more compact and relocated. The drive shaft is now located above solution level. Thus, no leakage is possible through shaft openings in the tank wall. 3) Saddles have been redesigned to permit operator to guide the barrel into position more easily. 4) An overflow trough is not needed and has been eliminated; thereby saving space inside the tank. 5) Now made of rigid angle-iron, the hanger assembly has been improved



to assure proper alignment of the cylinder and gears.

The new tank also features a push-button type motor starter, a bottom drain, melamine bushings for insulating bronze hanger pins, flexible dangler contacts on the barrel, coil risers that extend over the top of the tank, and two anode rods for each cylinder, on single as well as multiple units. To provide equal distribution of current into a barrel, negative and positive bus bars are furnished on each end of the plating tank.

Constructed of ¼" double electric welded steel plate, the tank comes in two sizes — 14" x 30" I.D. (solution capacity: 224 gal.) and 14" x 36" I.D. (solution capacity: 252 gal.). For acid solution, the tank comes lined with 3/16" vulcanized rubber, or plasticized PVC. For cyanide solutions, the tank is provided with rough wire glass

in back of anodes. Tank exteriors are painted in a rust-protective gray enamel with black trim.

Melamine or Plexiglas cylinders may be used with the tank. In operation, these cylinders are completely submerged in solution. Besides more consistent plating, completely submerged barrels have 20% higher load capacities and plate up to 25% faster. In zinc baths, total submersion minimizes chance of a spark igniting gases above the bath.

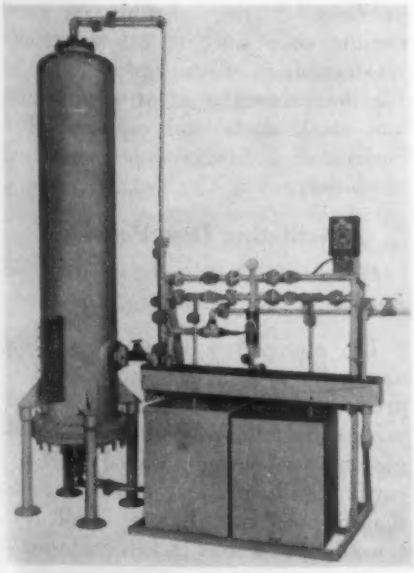
To facilitate tumbling and assure long life, the Plexiglas cylinder is constructed of a one-piece ribless mold with a specially-designed convex panel arrangement inside. This barrel could be used in plating solutions up to 180°F. Melamine barrels are used in solutions up to 210°F.

Mixed Bed Demineralizers

Barnstead Still & Sterilizer Co., Dept. MF, 223 Lanesville Terrace, Forest Hills, Boston 31, Mass.

The new line of mixed bed water demineralizers features the latest engineering developments in the ion-exchange process of water purification. Included is an improved system for regeneration of the purifying resins after they have become exhausted. Capacities run from a range of 50 to 2,500 gallons of mineral-free water per hour.

Impurities such as sodium, calcium, potassium, magnesium, iron, copper, chlorides, sulfates, bicarbonates, carbonates, etc. are eliminated. Even silica, carbon dioxide, and other weakly ionizable impurities are removed. This effective ion removal results in an effluent water of very high electrical resistance, often up to 20,000,000 ohms per cc. — and invariably higher than can be obtained with other types of demineralizers.



Cost of the demineralized water is low and thus can be used profitably in industrial applications requiring water of the highest purity.

Copper Cyanide Plating Addition

Lea-Ronal, Inc., Dept. MF, 42-48 27th St., Long Island City, N. Y.

Recently announced for precision and commercial copper cyanide plating purposes is Supertartral, an additive that offers distinct operating values over Rochelle Salts and other tartrates, resulting in better, faster, and more economical plating. The new product provides:

a — Superior anode corrosion.

b — Greater solution tolerance to numerous metallic impurities, chromium, calcium, barium, magnesium, etc.

c — Better deposits with less tendency to roughness caused by such metallic impurities as might be introduced with hard water.

d — Reduction in operating costs when used at recommended concentration: where operating characteristics at standard and bright baths utilize Rochelle Salts at 6 oz./gal., Supertartral offers a 20% saving over Rochelle Salts and 23% saving over potassium tartrate.

e — Better cyanide stability because

it reduces cyanide breakdown with its resultant carbonate formation.

The addition agent has been thoroughly tested in production volume in all methods of plating. Free samples for laboratory testing purposes can be obtained on request from the manufacturer.

Aluminum Powder Coating

Emjay Maintenance Engineers, Dept. MF, 327 Union Ave., Rutherford, N. J.

The perfection of a new material which makes it possible to metalize surfaces with aluminum, without the use of heat, was announced recently. The process is based on the development of a material called Kolmetal, a mixture of finely pulverized aluminum in a plastic base. The resultant coating, achieved by two applications of the product with a four hour drying time between applications, air hardens to a plastic bonded aluminum surface which can be polished, ground, drilled or bent to a 45 degree angle without chipping or cracking.

Exhaustive tests made in the laboratory, by independent testing companies and in actual service reveal that it has excellent resistance to atmospheric and sea water corrosion. It retains its finish and firm adhesion over a wide range of temperatures and demonstrates complete inertness to a long list of foods, beverages and liquid products.

The product is recommended as a coating for the interiors of all types of tanks — both to prevent the contents from contamination and to protect the interior from corrosive action of the contained liquid. It proves an excellent exterior coating for acid cooling coils since it has practically no insulating effect, and it is ideal for the protection of structural iron and steel, ducts and piping and a variety of industrial equipment and machinery.

Oscillating Disc Polisher

Flexentrik Corp., Dept. MF, 555 Fourth St., San Francisco, Cal.

The above firm is now marketing nationally a product that is said to produce grinding, polishing and sanding results hitherto unobtainable with portable power tools. Called the Flexentrik Oscillator, the new device is shaped somewhat like a small bell, consisting of a steel jacket, enclosing a

specially formulated heat resisting rubber. When interposed between the power unit and the abrading head it acts as a free floating, oscillating coupler, permitting full face contact of the abrasive disc or polisher, the manufacturer states. The oscillator is also said to lessen operator fatigue, prolong life of power tools by cushioning shock to motor bearings, and to eliminate all torque, jerking, scoring and grabbing, as well as clogging of abrasive. Oscillators are manufactured in sizes to fit all popular motor shaft threads, and are available in two types, General Service and Light Duty.

Protective Coating

Industrial Metal Protectives, Inc., Dept. MF, 401 Homestead Ave., Dayton 8, O.

Zincilate, a new conception of protective coatings which has successfully replaced galvanize, plating and multicoat painting methods on a variety of iron, steel and aluminum products, is described in a new, illustrated brochure just published by the above company.

Available in six basic formulations, it may be applied by spray, brush, dip or flow-coat methods, to new products or to existing structures. On many applications, one coat provides maximum protection against corrosion and abrasion, increasing the service life of the product and improving its appearance.

The brochure contains complete information on this self-protecting coating and illustrates several typical applications in varied fields.

Single Stage Phosphating Process

Metasurf Corp., Dept. MF, 12830 Eaton Ave., Detroit 27, Mich.

The above manufacturer has announced a new product known as Econocote, the most unique feature of which probably lies in the fact that no rinse is required. It can be used in a single stage spray washer for both cleaning and phosphating. Besides having exceptionally good cleaning characteristics, it creates an iron phosphate coating of between 25 and 40 mg. per square foot. It can be used for treating steel, cast iron, aluminum or zinc, and substantially improves paint adhesion.

Complete information on Econocote is contained in a new 4-page folder, and which may be obtained by writing to the above address.

Surface Measuring Instrument

Brush Electronics Co., Dept. MF, 3405 Perkins Ave., Cleveland 14, O.

A new instrument for measuring surface roughness is being manufactured by the company under an exclusive license from the General Motors Corp. It provides a non-destructive test, a vital factor in most operations. It is versatile, inexpensive, and requires no special knowledge or training for its operation.

The surface roughness range measured extends from 1 to 1,000 micro-inches average deviation from the mean surface. A variable cut-off switch permits the separation of waviness and roughness characteristics of surfaces by filtering out wave lengths exceeding .003, .010, or .030 inch. This feature is of vital importance in many applications such as bearing surfaces and highly stressed parts.

When the diamond tip stylus moves across the peaks and valleys of the surface to be measured, the microscopic mechanical motion is transformed by a movable plate vacuum tube transducer into electrical signals. These signals are amplified and indicated on the meter as surface roughness in micro-inches. An operator need only select the proper roughness and cutoff scales, guide the pickup over the work, and read the meter.

Complete accuracy is always assured because the Surfindicator is equipped with precision reference specimens which provide a simple and accurate calibration of the instrument. These surface roughness specimens comply with the American Standards Association, Standard B 46.2, and the Society of Automotive Engineers' requirements. Thus, the possibility of measurement errors with different operators and between different instruments is eliminated.

The instrument can be used anywhere; it weighs only 15 lbs., and occupies less than ½ cubic foot of space. It can be set up in any location where 115-volt, 60-cycle current is available.

Industrial Washing Machine

Cincinnati Cleaning and Finishing Machinery Co., Dept. MF, Sharonville, O.

A new industrial washing machine, just announced, features many innovations designed to make cleaning of a wide variety of miscellaneous parts quick and easy. Basically, the machine agitates a tray holding the parts through the cleaning bath, generally a solvent-type material.

An especial advantage of the unit is that it is loaded at normal working level. The operator need not raise or lower parts to be cleaned, and need not get his hands near or into the cleaning solution. No hoist is required. Parts are moved directly from the plant conveyor to the "tableheight"

tray of the machine, and similarly removed after cleaning.

At loading position, the tray is raised to the top of the tank, out of the cleaning solution. As it is level with the side of the machine, parts may be loaded directly and easily from a roller conveyor or other means. Parts may be loaded on the tray separately or in baskets, depending on size.

After loading, the operator presses a button which starts the machine. The tray sinks into the tank to operating level, where it is pneumatically "sloshed" up and down at the rate of 40 strokes per minute. The combination of the motion and the cleaning solution effects a clean surface in a remarkably short time, even with heavy deposits of soil.

At the end of the cleaning period (or automatically, if desired), the tray is raised to the loading position again and the clean parts removed onto the plant conveyor. The pneumatic mechanism is the only moving part on the machine; it operates at 100 p.s.i.

The tank can be operated cold or heated with steam, gas, oil or electricity. Temperature control is provided to hold tank temperature at any point between 80 and 212 degrees F. Maximum size of the machine is 6 feet long, 4 feet wide and 42 inches high; smaller sizes are made as required. The parts tray is designed for a maximum load of 400 lbs.

The tank is made of 10 gauge steel and may be insulated to conserve heat or for use in air conditioned plants. The tank lid is hinged and provided with a 160 degree F. fusible link for automatic closing in case of fire, when inflammable solvents are used.

Electroformed Screen

Pyramid Screen Co., Dept. MF, 45 Radnor Rd., Brighton 35, Mass.

Pure nickel is used exclusively, resistant to corrosion. Fine openings can be supplied, down to .001" and plate thicknesses are available from smaller than hole diameter or width, to several times the hole size. Conical shaped holes are provided, which greatly reduce blinding.

Holes can be round, square, or slotted, for varying requirements in preparation and stock sizes, about 40" x 40", with continuous coil available soon.

Electric Immersion Heaters

Glo-Quartz Electric Heater Co., Inc., Dept. MF, 37934 Elm St., Willoughby, O.

The introduction of a new line of metal sheathed Glo-Quartz electric immersion heaters offers a better way of heating alkaline cleaner tanks, cyanide plating solutions, and hot water rinse tanks because the nickel-alloy heating element is solidly embedded in a special fused quartz powder that provides excellent heat transfer properties while eliminating the occurrence of stray currents.

All units are constructed with standard, UL approved, vapor-proof, junction boxes for easy wiring.

These metal heaters are available in steel, red brass, and stainless steel in three different models from 1,000 watts to 26,000 watts, in all voltages including 550, in single or three phase.

Models listed from ME-28 to ME-49 (same as photo), are available with a thermostat mounted onto the junction box which is located at the side of the tank away from all vapors.

New Bright Nickel

United Chromium, Inc., Dept. MF, 100 East 42nd St., New York 17, N. Y.

The Unichrome bright nickel process has now been made generally available to the plating industry of the United States. The process, which was developed in the company's laboratories, has been completely tested and field proved in commercial operations. Many thousands of gallons have already been used in a wide variety of industrial nickel plating applications in this country and Canada.

Ease of control, stability, superior receptivity for chromium deposits, and, above all, economy are the major advantages, as established during its three years of operation. Platers have been most impressed by the stability of the primary brightener over a wide range of pH and other operating conditions, this stability resulting in lower, more economical rate of replenishment, also simplification of control.

High solubility is a characteristic of the addition agents. In many installations the new bright nickel has helped solve problems connected with low brightener solubility. It has, for example, minimized problems of brightener drying out on the work and brightener crystallizing on tanks and equipment after cooling of the plating solution. This solubility and the use of all-liquid addition agents have made maintenance easier and less time consuming.

The bright nickel provides a superior base for chromium plating. Exhibiting excellent receptivity for chromium deposits, it has significantly reduced "gray plate rejects" in numerous installations. It has been found that bright chromium can be deposited without activation on deposits which have been exposed to the air for as long as several hours. The deposits are also whiter in color, and, for this reason, subsequent chromium deposits appear to have greater sparkle, and chromium "misses" become less obvious. Superior tolerance for metallic and organic contaminants has been reported by users of the process. As a result, the bath is being operated with less frequent purifications.

Deposits exhibit high brilliance. The solution has a good rate of brightening. Other properties confirmed by commercial experience are very good protection against corrosion for the basis metal, good ductility, and very low internal stress of the deposits. Tests conducted by a major automotive manufacturer showed the internal stress of the deposit to be negative, indicating superior resistance to cracking of the deposit in service. Excellent adhesion of deposits has been the experience in all installations.

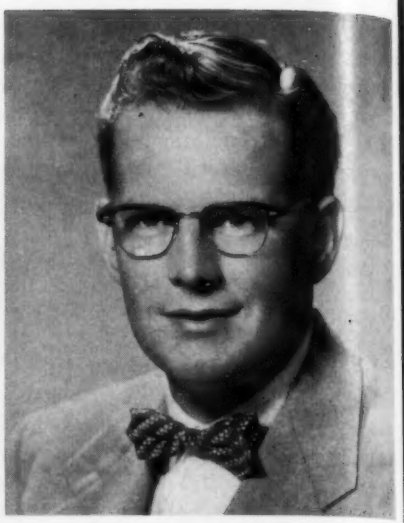
The new bright nickel solution is a nickel sulfate, nickel chloride, boric acid composition with special Unichrome addition agents. Most nickel plating solutions having a typical Watts formulation can be converted.

BUSINESS ITEMS

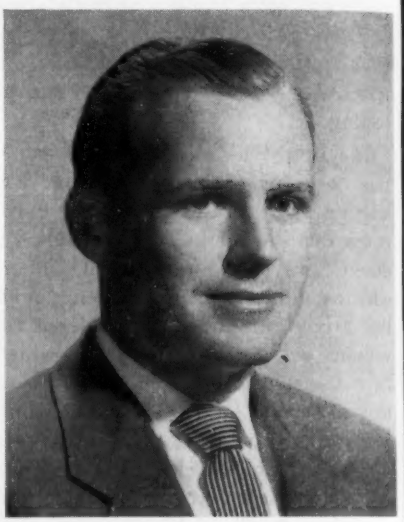
Oakite Appointments

Oakite Products, Inc., manufacturers of industrial cleaning and related materials, have assigned three new technical service representatives to territories. *Linden C. Watkins*, for several years foreman of the plating and hardening division of the Remington Rand, Inc., plant in Elmira, N. Y., is now the Oakite representative in Nassau and Suffolk Counties, Long Island, N. Y. *R. W. Krajicek*, formerly with the Phillips Petroleum Co., and a graduate in chemical engineering from

Linden C. Watkins



R. W. Krajicek



Joseph M. Newey

Gonzaga University, is now representing the company in the state of Montana. *Joseph M. Newey*, a graduate of the University of Utah, has been assigned to serve metal accounts in the Salt Lake City area.

The new service representatives recently completed an intensive, seven-week training course at the company's New York headquarters and in the field.

American Buff Appoints two New Representatives

American Buff Company, Chicago, manufacturers of buffs and polishing wheels, announce the recent appointment of two new sales representatives.

Howard A. Simons, with headquarters in Cleveland, will cover the northern Ohio district. For the past three years, he was with the Diebolt Safe and Lock Co., and for four years prior

Howard A. Simons

Armand C. Maran

to that, he was affiliated with Remington Rand.

Armand C. Maran, who will make his headquarters in Niles, Ohio, comes to the firm with an extensive background in the hardware field. Maran will represent the company in Northeastern Ohio, West Virginia and part of Pennsylvania.

Felix W. Saco Appointed Permutit Development Engineer

The Permutit Company, New York, N. Y., manufacturers of ion exchange resins and water conditioning apparatus for commercial and industrial applications, has announced the promotion of *Felix W. Saco* to the position of development engineer. In his newly-created office, he will be able to devote full time to the important work of developing the company's varied line of industrial products. To assist him in this work, he will have a staff of designers, draftsmen and test engineers.

Felix W. Saco

Mr. Saco joined Permutit in September 1952 and was assigned to the mechanical engineering department to work on the design and improvement of household water softeners. He attended New York University, receiving a Bachelor's degree in Mechanical Engineering in 1940. Saco is a member of the American Society of Mechanical Engineers and the Technical Association of the Pulp and Paper Industry.

Sarco Establishes San Francisco Sales Office

On October 15th, *Sarco Company, Inc.* established a new sales office at

35 Elmira St., San Francisco. This branch office will represent the company exclusively in Northern California.

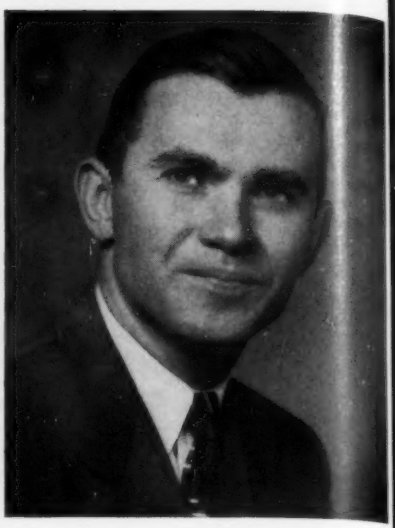
The company, manufacturers of steam traps, temperature regulators and heating specialties, has sales representatives in 71 principal cities.

J. S. Spear, sales manager of the new branch office, in San Francisco, has been associated with Sarco for over 15 years, serving as sales engineer in the New York territory. He is a professional engineer, a member of The Society of Plastics Engineers and the American Society of Heating and Ventilating Engineers.

Mr. Spear is experienced in the field and has a very thorough knowledge of the heating contract business, steam trapping and temperature control applications.

Consolidated Vacuum Appoints New Regional Sales Manager for Midwest

Appointment of *Gerald C. Waterman*, formerly of Rochester, N. Y., as the new regional sales manager for the middle western states, with headquarters at 919 North Michigan Ave., Chicago, Ill., has been announced by *A. H. Hartman*, director of sales for *Consolidated Vacuum Corp.* Mr. Waterman, a graduate mechanical engineer from Rensselaer Polytechnic Institute, joined Distillation Products Industries in 1950 and transferred to CVC when the Vacuum Equipment Department was sold to Consolidated



Gerald C. Waterman

Engineering. He was formerly in charge of sales in a territory embracing Western Pennsylvania, Ohio, Kentucky and Tennessee with headquarters in Rochester.

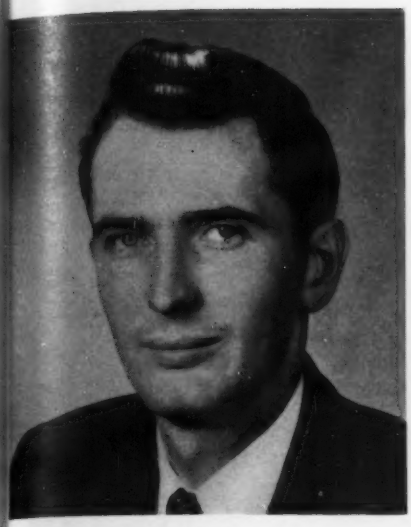
Mr. Waterman, a native of Ontario, N. Y., was a graduate of Ontario High School before matriculating at Rensselaer Polytechnic Institute. He served in an infantry platoon of the Armed Forces after which he returned to civilian life and completed his education. Besides his wife, he has two children, one four years and the other about six months.

Udylite Names Two Chicago Region Representatives

Joseph J. Schaefer and *Francis B. Bryant* have been appointed sales engineers in *Udylite Corporation's* Chicago regional sales office.

Schaefer, formerly with Parke, Davis & Co., Detroit, is assigned to

Joseph J. Schaefer



Francis B. Bryant

Chicago's northside sales district. A member of the *American Chemical Society*, he was graduated from the University of Detroit with a Master of Science degree in Chemistry.

Bryant's new headquarters are at Bettendorf, Iowa. The district includes western and southern Illinois, Iowa and Nebraska.

He is a graduate of Albion College, Albion, Michigan, and was associated with the Provident Mutual Life Insurance Co. before joining Udylite.

Turco Appoints Washburn

S. G. Thornbury, president of *Turco Products, Inc.*, manufacturer of chemical cleaning and processing compounds, announced the appointment of *Rear Admiral G. A. T. Washburn* as his special assistant in charge of facilities.

Early in 1954 ground will be broken on a thirty-acre site in North Wilmington, Cal., for a new million-dollar plant which will house all of the company's home-office manufacturing, sales, and administration. In this complex new operation a man of "Gat" Washburn's experience is indispensable.

G. A. T. Washburn

Admiral Washburn is the man who planned and supervised the building of the Naval Air Station at Glenview, Ill. He was also associated with Hughes Aircraft in Tucson in the construction of the plant and in the production of the U.S.A.F. guided missile program. He had the titles of plant engineer and manager, plant services.

Admiral Washburn, incidentaly, has had a very colorful career. He graduated from Annapolis in 1923 and earned his Navy wings the following year. He was one of the proponents and pioneers of the then controversial field of naval aviation and has logged 16,000 hours in the air.

During World War II he commanded two different aircraft carriers and participated in most of the major battles in the Pacific Theater. He earned the Navy Cross, two Combat Legions of Merit and other decorations. In July of 1948 he retired from the Navy by his own request.

Special Chemicals in New Location

The Special Chemicals Corp. has moved its office facilities to new and larger quarters at the Ossining plant. The address is 100 South Water St., Ossining, N. Y. Telephone: Ossining 2-5052.

Belke Modernizes Offices

Belke Manufacturing Co. has modernized its offices, as shown above. Upper left shows William E. Belke, founder and president of the company, seated at his desk in his private office. At right is the bookkeeping department.

Enthone Charges Infringement

In a suit filed in New Haven, Conn. on November 23, 1953, *MacDermid, Incorporated*, Waterbury, Conn. was charged with infringing a patent owned by *Enthone, Incorporated* of New Haven, Conn. The patent covers a method developed by Enthone for stripping nickel as well as some other metals. The complaint in the suit charges that MacDermid, Incorporated, has been inducing metal goods manufacturers and electroplaters to infringe the patent and has been supplying a chemical composition for use in practicing the patented method. The suit asks for an order of the Federal Court prohibiting MacDermid from continuing its practice as well as from selling any form of composition infringing the patent. It also asks for

money damages caused by MacDermid's infringement of the patent since its issue on August 19, 1953. The patent is No. 2,649,361 issued to *Dr. Richard Springer* and *Dr. Walter R. Meyer*, assigned to Enthone, Inc.

Industrial Systems Co. Moves to Matawan, N. J.

Industrial Systems Company, formerly of New Brunswick, has moved to 32 Main Street, Matawan, N. J., in order to facilitate its function as exclusive distributors for *Industrial Washing Machine Corp.* of Matawan.

Industrial Systems is sales representative for the washing and metal treating machines manufactured by Industrial Washing Machine and also for I.S.C. conveyor systems.

New Anodizing Firm

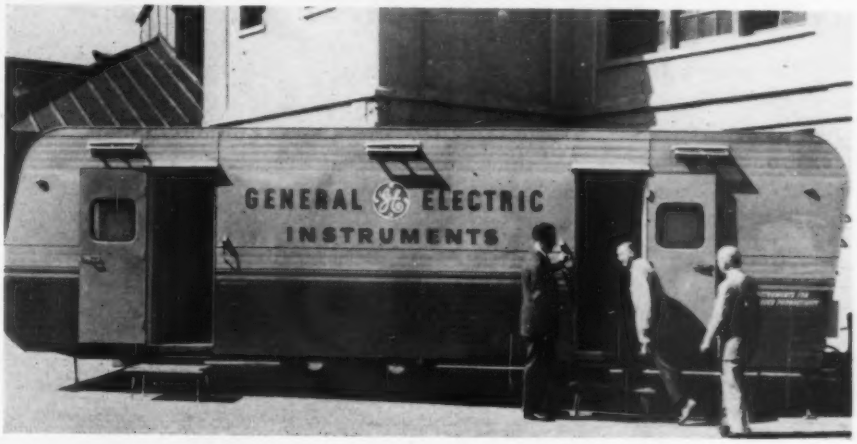
Roland G. St. Denis, president, announces the incorporation of *Aluminum Anodizers, Inc.*, specializing in clear and color anodizing to government and commercial requirements. The firm, which has been engineered to be one of the most modern in New England, is located at 154 Globe Mills Ave., Fall River, Mass., with a branch office at Holden, Mass.

General Electric Specialty Instruments' Display Coach to Begin Nation-Wide Tour

A streamlined exhibit trailer featuring demonstrations and applications of General Electric specialty instruments for increased productivity began a year's tour of the United States late last year.

According to *Hudson S. Day*, manager of specialty instrument sales for G-E's Meter and Instrument Department, the "Measurement-mobile" will make more than 250 stops in key industrial areas and will be inspected by more than 15,000 instrument users throughout the nation.

The traveling exhibit will emphasize widening present-day applications of instruments in production testing, process and quality control, laboratory analysis, control and analysis of electric utility systems, and measurement for service and maintenance of equipment. About 40 instruments, ranging from atomic radiation measuring equipment to leak detectors having the "keenest noses in industry," will be available for on-the-spot demonstrations. Specialists familiar with



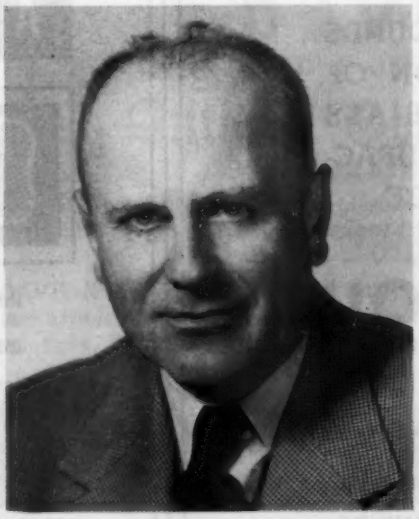
all the displayed products will conduct tours for selected instrument users.

The "Measurement-mobile" is 31-feet long and 8-feet wide. It is drawn by a ½-ton carry-all sedan. The exhibit contains its own power supply, heating system, and air-conditioning unit.

Magnus Chemical Co. Elects Vice-Presidents

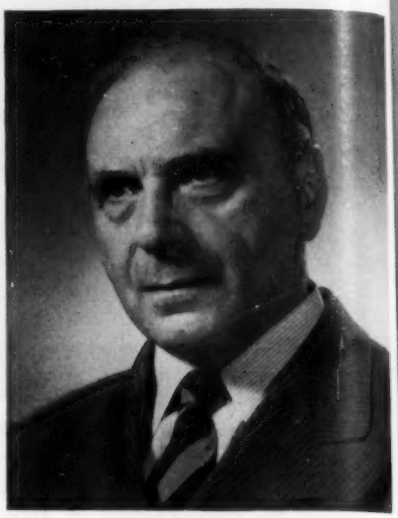
At the recent annual meeting of the board of directors of the *Magnus Chemical Co., Inc.*, manufacturers of industrial cleaning materials, metal working lubricants and metal cleaning equipment, *Roy D. King* and *Marcel Zinty* were elected vice-president's of the company.

Mr. King who has been manager of the Railroad Division of Magnus for the past 5 years was made vice-president in charge of railroad sales and development.



Roy D. King

Mr. Zinty who, before coming to the company as manager of the Equipment Division, was chief engineer of Mabor and Co., Paris, France, was made vice-president and general manager of the Equipment Division.



Marcel Zinty

Davies Opens Kansas City Branch

L. A. Davies, president of the *Davies Supply & Mfg. Co.*, has announced the opening of a Kansas City Branch. The new office at 814-16 West 17th St., will be headed by *Dick Loupee*. Replacing him as sales representative in the St. Louis and Southern Illinois territory will be *Arthur P. Wrisberg*. After attending Washington University and City College of Law and Finance, Wrisberg was with Lasalco, Inc. of St. Louis. His 14 years there included

Dick Loupee

ervice in the Navy during World War II.

New District Representatives and Branch Offices for Industrial Filter

George J. Dawson

The Industrial Filter & Pump Mfg. Co., announces the following factory district representatives in sales and service engineering for their line of pressure filters, demineralizers, heat exchangers, salt fog test cabinets, centrifugal pumps, rubber lining service, and waste treatment systems.

George J. Dawson will cover Pennsylvania and western New York from the new branch offices at 834 Lovitt Way, Pittsburgh 12, Pa. and 808 Land Title Building, 1400 Chestnut Street, Philadelphia, Pa. Before joining the company he was a staff chemist with Infilco, Inc. and engineer and chemist for Commonwealth Edison Co., Chicago.

Gil Valentine

James Filkins

Gil Valentine is covering the state of Michigan from the new Detroit branch office at 424 Book Bldg., Detroit, Mich. He was previously sales and service engineer in the plating chemicals division of the McGean Chemical Co., sales engineer with Wagner Bros., Inc., and sales manager of technical processes with Promat Division of Poor & Co.

James Filkins will cover the States of Texas and Oklahoma from the new Dallas branch office at Dorchester House, Dallas, Tex. Previously, he was analytical and development chemist for Pure Oil Co. and manager of the petroleum section for Commercial Testing & Engineering Co.

William O. Bosserman Heads Anodes Division for Sipi Metals Corporation

William O. Bosserman, it is announced by *Maury E. Lippert*, vice-president in charge of sales, of *Sipi Metals Corp.*, 1720 North Elston Ave., Chicago 22, Ill., has been named managing engineer, Anodes Division of the company.

Mr. Bosserman, for the past 25 years, has been associated with the non-ferrous field. His experience embraces all phases of plating problems as related to anode use, particularly in the copper and zinc base fields.

In assuming charge of the Anodes Division, he will be active in field sales and engineering throughout the company's entire sales area.

The company also announces the opening of its Cincinnati office and the appointment of *Joseph H. Homan* as district manager.

Homan, a native of Cincinnati has been associated with the non-ferrous metal business for over thirty-three years. A member of the Cincinnati Club and the Kenwood Country Club, he has been active for years in Cincinnati community work.

Louis P. Schweer and *Joseph L. Homan* have also been appointed salesmen for the Cincinnati District.

Sweatt Elected as Chairman of Honeywell Board

Harold W. Sweatt, president of *Minneapolis-Honeywell Regulator Co.* since 1934, was recently elected chairman of the board, succeeding *Mark C. Honeywell*, who was named honorary chairman.

Paul B. Wishart, vice-president and general manager of the company, was elected to succeed Sweatt as president.

At the same time two other officers of the company were elected directors, enlarging the board's membership to 10. The new directors are *Tom McDonald*, vice-president in charge of sales, and *A. M. Wilson*, vice-president in charge of the firm's Aeronautical Division.

The top-level changes in the management of the world's largest producer of automatic controls coincided with the retirement of five officials under the company's executive retirement plan established in 1943.

The retiring officials include, in addition to Honeywell, another executive who has been a member of the company's top management since the firm was organized under its present corporate structure in 1927.

He is *W. L. Huff*, director, executive vice-president and former treasurer.

Others retiring are *R. P. Brown*, vice-president and chairman of the board of the company's Industrial Division in Philadelphia; *George A. DuToit*, vice-president in charge of manufacturing, and *L. Morton Morley*, vice-president and formerly in charge of sales for the Industrial Division.

Honeywell, Huff and Brown will continue as directors.

Diversey Purchases Sanitary Products, Ltd.

The Diversey Corporation, has announced that its Canadian affiliate, *The Diversey Corporation (Canada) Ltd.*, has purchased controlling interest in Sanitary Products, Ltd. of St. Johns, Newfoundland. The firm is Newfoundland's largest distributor of hotel and restaurant supplies and industrial and maintenance materials.

H. W. Kochs, chairman of Diversey, said the purchase will enable the Canadian affiliate to provide better service to its Newfoundland customers and to extend its operations to Greenland and Labrador. New warehouse facilities are being erected immediately and manufacturing facilities are contemplated.

Officers and executives of Sanitary Products, Ltd., will continue in their present capacities. *N. P. Maxwell* is managing director.

Republic Chemical to Produce Nickel Sulphate

Joseph J. Darvin, president of *Republic Chemical Corp.*, 94 Beekman St., New York announced recently that rapid progress is being made towards completion of installation of machinery and equipment to produce nickel sulphate at its plant. Shipments are scheduled to commence during January.

The plant is of the most modern design and will produce four million pounds nickel sulphate annually. The latest technological advances in production are being utilized by the engineering and chemical staff.

Cooper Elected Vice-President of International Nickel of Canada

Lance H. Cooper, of London, chairman of *The Mond Nickel Co., Ltd.*, has been elected a vice-president of its parent company, *The International Nickel Co. of Canada, Ltd.*, *Dr. John F. Thompson*, chairman of the board of directors of Inco, announced. He will assume his new office on January 1, 1954.

Mr. Cooper joined The Mond Nickel Company as chief accountant in 1926, and in 1928 was appointed secretary of the company. In 1945 he became a director of Mond and subsidiary companies, and subsequently served also as an assistant secretary and assistant treasurer of International Nickel of Canada. He was named chairman of Mond in January, 1951.

Mr. Cooper served in World War I as a gunner officer and in World War II as a major in the Home Guard, being awarded the Member of the Order of the British Empire (M.B.E.) for the latter service.

Pangborn Plans Events for Golden Anniversary Year

The year 1954 will mark the celebration of the Golden Anniversary of *Pangborn Corporation*, Hagerstown, Md., manufacturer of blast cleaning and dust control equipment.

Thomas W. Pangborn, president, sold his first sand blast machine in New York City in 1904. *John C. Pangborn* joined his brother the following year. Growth was rapid and a plant was established in Jersey City in 1909. These facilities were outgrown in 1912, at which time the business moved to Hagerstown.

Pangborn's facilities in Hagerstown include foundry, plate, sheet metal and machine shops, assembly plants, paint and woodworking shops. A beautiful public park, a gift of the Pangborn brothers to the city, is located adjacent to the plant.

A series of events are being planned to celebrate the Golden Anniversary Year culminating on Sept. 1, 1954, the official birthday of the firm.

White-Roth Machine Corp. Appoints Distributor

George Roth, president of *White-Roth Machine Corp.*, Lorain, Ohio, announces the appointment of *Motch and Merryweather Machinery Co.*, Cleveland as regional distributor for the company's BurrMaster, a new tumbling machine.

Sales in Eastern Michigan, Ohio, Western Pennsylvania, Kentucky and West Virginia will be handled by forty sales engineers of Motch and Merryweather's New Machinery Distributor Division.

Roth points out that 50 year old Motch and Merryweather has four conveniently located offices to give prompt sales and service attention. Future sales inquiries from the above territory on the tumbling machine should be addressed to Motch and Merryweather at 715 Penton Bldg., Cleveland, Ohio; 2842 West Grand Blvd., Detroit, Mich.; First National Bank Bldg., Cincinnati, Ohio; and Clark Bldg., Liberty and Wood Sts., Pittsburgh, Pa.

James R. McBrien Promoted by Diversey

James R. McBrien, assistant division manager of *The Diversey Corporation's* Eastern division since 1949, has been named manager of the North Central division.

McBrien joined the company in 1936 spending four years as a field representative in the East. His impressive record earned him promotions to district manager in 1940 and assistant division manager in 1949, Eastern division. His new position will take him to Minneapolis — North Central division headquarters.

New Plant of Hoffman Company

Completed recently and now in full operation, this new plant of Hoffman Co. has twice the floor area of former operations yet through more efficient shop planning and improved shop practices the company expects to more than triple its out-put of metal baskets, trucks, racks and other materials handling equipment of its Roll-Way line. The new plant is located at 2580 W. Philadelphia St., York, Pa., was completed in less than a year from the time of its first conception.

Cowles to Expand Skaneateles Falls Plant

Cowles Chemical Co., with general offices at Cleveland, Ohio has announced that construction of a 20,000 sq. ft. addition to their plant at Skaneateles Falls, N. Y. is now under way.

When completed in mid-1954, the addition will make available increased warehouse space and provide for a new plant office and control laboratory, as well as expanded research facilities and pilot plant operations.

Directors of the company, which has been a producer of industrial chemicals since 1885, approved the addition last week.

PATENTS

(*Continued from page* 81)

Machine for Buff Manufacture

U. S. Patent 2,650,861. *Sept.* 1, 1953. *L. W. MacFarland, assignor to Jackson Buff Corp.*

A machine for the manufacture of annular buffing units of the type described, comprising a pair of spaced and axially alligned drums, a clamping ring, a series of overlapping rigid blades, means for pivotally supporting each blade to form a ring of the overlapping blades around the space between the aligned drums, means for swinging the blades on their pivots to extend inwardly between said drums to collapse and shirr material wound on the surface of the drums, means for the application of pressure in an axial direction to cause the clamping ring to embrace the material of the annular buff unit at the inner periphery thereof, and means for withdrawing the said blades.

Plating on Magnesium

U. S. Patent 2,650,902. *Sept.* 1, 1953. *W. F. Higgins, assignor to Magnesium-Elektron Ltd.*

A process for the treatment of magnesium and magnesium base alloys which consists in immersing the magnesium-containing article in a first solution of a compound selected from the group consisting of the salts of zinc, cadmium, and manganese which are soluble in water and are decomposed by the magnesium to produce a metallic coating of one of these metals on the article, contacting the coated article with an aqueous chromic acid solution which leaves the surface of the metallic coating in a passive condition, and then contacting the coated article with a solution of at least one of the salts of the group consisting of a cyanide of mercury and a nitrate of mercury which leaves the surface of the metallic coating in a condition suitable for electroplating, and thereafter electroplating the coated article.

Plating on Aluminum

U. S. Patent 2,650,901. *Sept.* 1, 1953. *K. L. Van der Horst, assignor to Van der Horst Corp. of America.*

The method of preparing an aluminum article for electroplating which comprises vapor blasting that portion of the article that is to be plated, with a mixture of air, water and abrasive particles and thereby breaking down the adherent film of oxide thereon to expose a new surface, the abrasive particles being of from about one hundred mesh to about twelve hundred and fifty mesh, and subjecting said portion of the article to the action of caustic alkali and alkali zincate to produce a deposit of zinc on said portion of the article.

Protection of Molybdenum Against Oxidation

U. S. Patent 2,650,903. *Sept.* 1, 1953. *J. W. Garrison and A.B. Lovett, assignors to Westinghouse Electric Corp.*

The method of protecting articles of molybdenum and alloys thereof consisting mainly of molybdenum against oxidation, comprising placing said article in a solution of a salt of cobalt, electroplating cobalt from said solution on said article, making a slip of finely-divided silica and glass, applying a coating of said slip to the plated article, drying, and fusing said coating thereon in a hydrogen atmosphere at a temperature above 1300°C. and high enough to generate hydrogen silicide and cause it to react with the surface of said article.

Glass-To-Metal Seal

U. S. Patent 2,651,144. *Sept.* 8, 1953. *R. T. Foley and H. A. Omley, assignors to General Electric Co.*

The method of making a cast glass-to-metal seal between a glass body and metal member composed of an alloy of iron and a metal of the group consisting of nickel and cobalt, which comprises electrodepositing a layer of silver on said metal member, annealing the silver-plated member in a hydrogen atmosphere to effect a partial diffusion of the silver layer into the metal member, electrodepositing on the silver layer a thin layer of indium and casting a glass having substantially the same coefficient of expansion as said metal member into contact with the indium-plated portion of said metal member.

News from California

By Fred A. Herr

Planet Plating Co., was organized in mid-November as a result of the merger of facilities of three Southern California finishing shop owners with limited production ranges, and early in December opened for business in a 75 x 75 foot plant at 7902 Woodley Avenue, Van Nuys, Cal.

Associated in the venture are *Joseph Lear*, *Charles Jones* and *Emil Dentino* who, respectively, had operated a black oxide plant, a polishing shop, and a plating company in various sections of the San Fernando Valley district of Los Angeles.

Motivating factor in the merger was the desire on the part of Lear, Jones and Dentino to achieve greater production potential by consolidating their individual facilities. Incorporation details were completed in November, when the new name of Planet Plating Co. was assumed, and machinery from the three plants moved into the new factory. Planet Plating specializes in

decorative chromium, black oxide finishes and all types of lacquering and polishing on items ranging from lamp parts to belt buckles. *Dale Bell* is plating foreman.

Details of transfer were completed in December whereby Great Lakes Industries, Inc., Chicago, Ill., took over Cadmium & Nickel Plating Co. of Los Angeles, which is now being operated under the name of Cadmium & Nickel Plating Division of the mid-western concern.

Involved in the sale was a high production finishing plant at 1400 Long Beach Blvd., Los Angeles, valued at approximately $750,000 in building and equipment inventory. The firm has 50,000 square feet of floor area devoted to finishing purposes of all varieties, including full automatic and production barrel plating, and mechanical chromium plating.

A plant remodeling program was initiated by the new owners in December involving enlarging and streamlining operations in the shipping area. *T. M. Dreaver* of the Great Lakes Industries' Chicago office has been named head of the Los Angeles division. *E. T. Brown* (past-president of the Metal Finishing Assn. of Southern California) continues as vice-president and general manager, and *E. Cranor Richter* as sales director.

Hughes Aircraft Co. has completed setting up a new heat treating department in its Culver City, Calif., plant. Added to hold-over furnaces were six new furnaces for heat treating steel, electronic, aircraft and armament parts. The new installation triples the firm's heat treating area and the work range.

Realignment of the plating division has also been completed to speed up operations and increase production. New equipment installed includes automatic line for chromating aluminum and one for treatment of magnesium. Ear-marked for installation early in 1954 is a conveyor to serve the 200 foot long shop in expediting the movement of parts from the finishing to the packing areas.

The equipment described above followed an earlier installed new burring department with a 5-barrel unit, complete with loading and unloading tracks, for automatic burnishing of parts formerly manually burnished. *Al Sulzinger* is foreman of plating and heat treating and *Ed Nicodemus* assistant foreman.

Louis Shoals, formerly sales engineer for various Southern California plating equipment manufacturers, is now a member of the executive sales staff of the Los Angeles Ambassador Hotel, where the 1954 educational session of Los Angeles A.E.S. Branch will be held in March.

S. G. Thornbury, president of Turco Products, Inc., Los Angeles, Cal., has announced that ground will be broken early in 1954 for a new million dollar plant to be erected on a 30-acre site in North Wilmington, Cal. The new building will house all of the company's home office manufacturing, sales and administration facilities now located at 6135 S. Central Ave., Los Angeles.

Mr. Thornbury also announced the appointment of *Rear Admiral G. A. T. Washburn* as his special assistant in charge of facilities. He will spearhead the Turco expansion program with a valuable background of experience in the planning and supervising fields. He planned and supervised the building of the Naval Air Station at Glenview, Ill., and was also associated with Hughes Aircraft Co. in the construction of its Tucson, Ariz., plant, and in the production of the U.S.A.F. guided missile program.

Smith-Emory Co., has moved its chemical engineering and testing laboratories from 920 Santee St. to new and larger quarters at 781 E. Washington Blvd., Los Angeles. The new physical testing laboratory includes a 600,000 pound compression machine and universal testing machines of 440,000, 120,000 and 60,000 pounds; also hardness, small tensile and abrasion testers; and separate laboratories for analyzing metals, paints, water, organic materials, crude petroleum, metaleographic work and spectrographic examinations.

The Sundmark Supply Co's. main building at 1700 Gage Ave., Los Angeles, is being given a brand new modern facade as part of an enlargement and remodeling program intiated by President *Roger Sundmark* concurrently with the widening of Gage Avenue by the city. The revisions will triple the floor area of the plating supply distributing firm. *Herman Ey*, formerly regional sales manager for Kelite Products, Inc., in the New York area, has been added to the Sundmark sales engineering staff.

Minneapolis - Honeywell Regulator Co. has a program underway for remodeling its former main plant at 8775 Mefford St., Los Angeles, into a regulator assembly facility. The remodeling is under the direction of *Burke W. Wombacher*, former plant engineer for Spar-Tan Engineering Co., Los Angeles, who now holds the post of plant engineer for Minneapolis-Honeywell. Wombacher also served as co-ordinating construction engineer for the firm's recently completed new plant in Gardena, Cal.

LOS ANGELES BRANCH

A talk on "Vapor Degreasing and Organic Finishing" by *William A. Vensel*, president of the Vensel Company, Los Angeles, featured the educational session program of the December 9 meeting of Los Angeles Branch of the A.E.S.

Mr. Vensel ranks as one of the best informed engineers in the country on the subject of degreasing. A graduate of Carnegie Institute of Technology, he served ten years as chief engineer with the Hubbard Company and an equal period as west coast district manager for the Detrex Corp. of Detroit, Mich., before establishing the William A. Vensel Co. at Los Angeles in 1945 for the manufacture and design of paint finishing systems.

In his talk before the 90 members and guests who attended the year's last meeting sponsored by the platers' society, Mr. Vensel discussed degreasing in all its phases. His coverage included proper degreasing equipment, methods of operation, safety factors, advantages of different degreasing solvents, conservation of solvent, and short cuts to economical, rapid and thorough degreasing and surface preparation prior to electroplating and organic finishing.

The speaker presented a resume of the history of vapor degreasing, traced the development of immersion machines, and the subsequent rise to popularity of vapor spray degreasing machines. The advantages of spray degreasing to assure proper adhesion and permanence of coating, of spray agitation to remove buffing impurities, and of automatic degreasers for time-schedule work were discussed in detail.

Mr. Vensel described the automatic degreasing machines now available for larger shops with large volume for which vapor degreasing is used as a pre-cleaning operation. He also touched upon problems of degreasing prior to enameling, spray agitation etc.

A half-hour question - and - answer period was held after the conclusion of Mr. Vensel's talk.

It took some members three seconds, others ten minutes, to realize that they were being taken for a ride after *Roy*

Lostutter and president *John Millhorn* had gravely announced that the next speaker was a world renowned authority on nuclear fission and would address them on "Some Technical and Non-Technical Aspects of Atomic Energy."

The speaker, *Russell Linskog*, an amateur comedian, proceeded to regale the members with some of the most outrageously impossible predictions of what atomic energy will do for industry, including plating shops. Platers will be able to apply coatings of one millionth of an inch in thickness in a flash dip of two-millionths of a second immersion time. But a minor drawback will be, "Doctor" Linskog explained solemnly, that a lead shortage will probably result because tanks will need linings of lead seven feet thick to protect the workman against atomic radiation. The speaker almost tumbled from the dias from his violently gymnastic description of what happens when a neutron meets a proton in a cylotron. The speaker's attempt to explain the chain reaction of nuclear fission was a masterpiece of high-class nonsense and provoked gales of laughter. Even the waitresses laughed.

The branch's membership drive under the energetic direction of first vice-president *G. Stuart Krentel* is gaining momentum each month. To the 20 new members of record at the November meeting, seven new ones were initiated on December 9, with applications on hand from seven others for validation at the January meeting.

William Nairne, general chairman of the 1954 educational session, held a meeting of his sub-chairmen prior to the general session to get the ball rolling on arrangements for the March affair in the Ambassador Hotel.

San Francisco Branch

San Francisco Branch of the A.E.S. has regretfully accepted the resignation of its president *Stuart W. Pankey*.

In a letter read at the branch's meeting held in Gino's Cafe in San Francisco, Mr. Pankey revealed that the press of his business affairs made it difficult for him to devote sufficient time to his presidential duties and asked to be relieved. His wish was granted.

Four new members were initiated. These were: *Harold G. Spots*, Burlingame, Cal., representative of the Diversey Corp.; *Alan H. Nicholson* of the A. J. Lynch Co., San Francisco staff; *Howard J. Lackey, Jr.*, of Industrial Materials Co.; and *John B. Agostinetto*, Western Gear Works, Redwood City.

The chapter's social activity was high-lighted by a Christmas Party held December 11 at the Italian Village in San Francisco.

Secretary *Horace J. Smith* reports that *Myron Diggin* of Hanson-Van Winkle-Munning will address the branch in March, either on the 18th or 25th, depending on Mr. Diggin's schedule at that time.

OBITUARIES

WM. R. SHIELDS

William R. Shields, who established the Wm. R. Shields Co. in 1937, died recently at his home in Beverly Hills, a suburb of Detroit. A member of the A.E.S., he was well known in the metal finishing field.

The firm, which specializes in plating and metal finishing equipment, will continue under the leadership of

William R. Shields

his daughter Carolyn, who has been with the company for the past ten years.

WM. J. WEDER, SR.

William J. Weder, Sr., a plating executive at General Electric Co. in Philadelphia, died recently of a heart attack. Mr. Weder, who had many friends in the plating field, was a member of the Philadelphia Branch of the *American Electroplaters' Society*.

NEW BOOKS

Modern Electroplating

Edited by Allen G. Gray. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 1953. Price: $8.50. 563 pages, including index.

Published under the sponsorship of The Electrochemical Society, this volume comprises a completely modernized revision of the earlier edition (1942), now out of print. Written by 39 authorities in the field of electrodeposition, all the current plating processes are surveyed in detail and a section is included on uncommon metals, which are not at present commercially deposited.

Not only the application of the metals but the control of the solutions and the theory underlying each operation will be found in these chapters, and the references and bibliography will meet the requirements even of the most critical researcher. The treatment of each metal is uniform, the pattern of presentation consisting of principles, functions of bath constituents, operating conditions, maintenance and control, base metal preparation, and whatever peculiar characteristics of the individual process require explanation.

The book is a must for the metal finisher's library, because it is encyclopedic in its scope and emphasizes both the theory and practice in its treatment of the subject of electrodeposition.

Chemical Engineering Catalog

Published by Reinhold Publishing Corp., 330 West 42nd St., New York 36, N. Y. 1953. 1,955 pages.

Available to purchasers of engineering materials and equipment, the 1953-54 edition of this catalog contains precise and factual information on products and services offered by over 500 leading manufacturers and suppliers, and helps to simplify the search for needed information on materials of construction, chemical equipment and related subjects. Revised yearly, the catalog has been able to keep up with the rapid advance in chemical process

industries so that all the information is completely up to date. The volume is indexed by company name, trade name, functions, equipment, plant services and pilot plants.

Journal Electrodepositors' Technical Society

Published by Institute of Metal Finishing. 32 Great Ormond St., London, W. C. 1. 1953. 291 pages plus index. Price: 2 Guineas.

Volume 28 covers the proceedings of the Institute for 1951 and 1952 and includes the papers presented at the various meetings during those years, together with the discussions which followed the presentation of each paper. The papers, on all aspects of metal finishing, live up to the standard of excellence the industry has come to expect of our British coworkers.

We have been privileged to reprint a few of these papers in METAL FINISHING but these have been just a small sampling of the invaluable information to be found in the volume among the papers authored by most of the prominent figures of the British segment of the industry.

LETTERS TO THE EDITOR

METAL FINISHING
381 Broadway
Westwood, New Jersey

Attention: Editor

Dear Sir:

In the August, 1953 edition of your magazine there is a lead editorial entitled, "Hydrogen Embrittlement." In this feature is the following statement:

"Abrasive blasting and tumbling, instead of acid pickling to remove scale, are the obvious suggestions. Although, where practicable, these alternatives are the ones commonly employed, a subsequent acid dip is almost a must for deposit adhesion."

I should like to take exception to Mr. Hall's statement that acid dipping is a requirement for good deposit adhesion. I maintain that not only can hydrogen embrittlement be eliminated through the use of Pressure Blast wet-blasting equipment but any type of chemical immersion employed solely for deposit adhesion may also be eliminated.

Very sincerely,
The Cro-Plate Company, Inc.
Alan R. Burman,
Vice-President

The Editor,
METAL FINISHING

An interesting technique was described in recently issued patents (U.S.P. 2,554,256, Can. P. 481,743) for blackening the surface of freshly abraded alumnium by brief immersion in a hot aqueous solution containing ammonium molybdate, ammonium chloride and sodium acetate. Brief experiments have indicated that a new solution blackens satisfactorily but that after working the solution for a while the effect changes to produce a mottled grey or grey-black color. It has been found that this grey color can be altered to a satisfactory black by a brief dip in a cold acid solution (preferably nitric, sulphuric or acetic acid) following treatment in the worked molybdate solution. This technique extends the working life of the latter solution.

Dr. R. C. Spooner
Aluminum Laboratories Ltd.

TECHNICAL LITERATURE

Research Reports on Metal Finishing

By GEORGE W. GRUPP

The Defense Department recently declassified two reports which should be of interest to METAL FINISHING readers. One is a 29-page thesis on "The Electrodeposition of Chromium Alloys" by Alfred Taboada of Rensselaer Polytechnic Institute, illustrated with tables, photographs, and drawings.

This report tells how "empirical studies were made of the possibility of co-depositing other metals with chromium to obtain desired properties."

The procedure and equipment used in these studies are described as well as the experimental results with titanium-chromium deposition; nickel-chromium deposition; and iron-chromium deposition.

The experiments demonstrated that titanium can only be deposited as a trace with chromium in the solutions studied. The "cracked structure" normally found in chromium deposits can be improved but not eliminated, when plated from chromic acid solution, by making the sulfate addition in the form of nickel or ferrous sulfate and increasing the molar ratio of chromic acid to sulfate to 10 to 1." Increasing the ratio beyond this point did not improve the deposit.

All deposits made in these experiments had about the same hardness and efficiencies.

Nickel, it was found, could not be substituted for iron in the "chromealum" bath if an even adherent deposit was desired.

Iron and chromium, it was learned, could be co-deposited from a chromic acid bath "with as high as 10 per cent iron in the deposits, when using ferrous sulfate as an addition agent."

None of the experiments revealed that a deposit of an alloy of chromium increased the plating efficiency or completely eliminated the cracked structure.

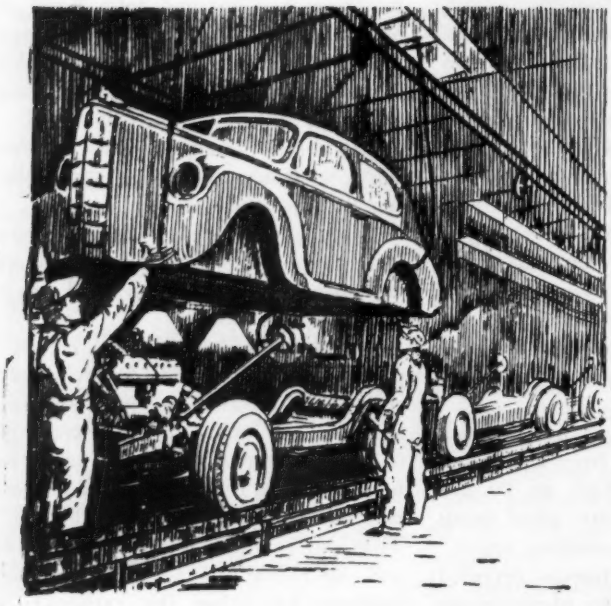
The second recently declassified report which should interest METAL FINISHING readers is on "Vapor Deposition of Metals on Ceramic Particles." This 12-page study, illustrated with drawings and photographs, was made by James E. Cline and John Wulff of Massachusetts Institute of Technology for the United States Air Force, Air Material Command, Wright Paterson Air Force Base, Dayton, Ohio.

The ceramic materials used in this study were alumina, silica sand, silicon carbide, and titanium carbide.

Three special series of tests were made: vapor deposition of iron; vapor deposition of molybdenum; and vapor deposition of nickel.

The tests revealed that "ceramic particles can be coated with relatively refractory metals, as molybdenum, tungsten and tantalum. That coatings of less refractory metals, such as nickel or iron, can be made by decomposition of the volatile carbonyls." Titanium carbide, it was found, was not adaptable to vapor deposition coatings by either the carbonyl or chloride processes. And the impregnation of a porous ceramic body with metal was found to be impractical.

Microfilms or photostatic copies of these reports can be purchased from the Library of Congress, Washington, 25, D. C. at nominal costs.



MOTOR CITY PLATING NEWS

Frederic B. Stevens Announces Staff Promotions

Promotions of six staff personnel at *Frederic B. Stevens, Inc.*, were announced by *W. J. Cluff*, president of the plating and foundry supply firm.

Frank Watt, new general sales manager for the metal finishing and foundry divisions, formerly was sales manager for the metal finishing division. He joined the firm in 1934 as a sales engineer.

Frank Watt

Guy Cummings, an electrical and sales engineer, takes over Watt's

Guy Cummings

former post. *Clair Crawford*, a service engineer, has been named sales manager for the foundry division.

Ralph L. Eastman

Ralph L. Eastman, new consultant on all metal finishing operations, formerly was manager of the buffing composition department. *Durwood J. Swaninger*, formerly assistant manager of the buffing department, has been named sales manager of buffing compositions.

Dr. J. A. Ridderhof, formerly manager of the foundry facing department, has been appointed manufacturing manager and director of research for the foundry facing and buffing composition departments. He has been with Stevens for 26 years.

Pennsalt Appoints Stoddard District Supervisor in Michigan

W. J. Stoddard has been named district supervisor in the Michigan district for the Metal Processing Department of *Pennsylvania Salt Mfg. Co.*, it was announced by *J. J. Duffy, Jr.*, sales manager.

In this new position, he will supervise sales and service activities in the Michigan area for Pennsalt metal cleaners, Fosbond phosphate coatings and Fos Process lubricants for cold working.

Mr. Stoddard, well-known in metal working circles in the Detroit area, has a background of 23 years service with the company. Prior to joining the Metal Processing group as a sales-service engineer in 1941, he worked in the laboratory at the Wyandotte, Mich., plant. He and his family make their home in Wyandotte, Mich.

Michigan State Alumni to Meet

The Michigan State College alumni in the electroplating field are planning a breakfast reunion in connection with the annual meeting of the *American Electroplaters' Society*, to be held in New York City during July. All former students of *Professor Ewing* are invited, together with other alumni who are interested in the electrodeposition of metals.

Announcements will be sent later to all Michigan State alumni known to be in this field, but since such lists are necessarily incomplete, requests for further notification should be sent in promptly. Reunion plans are being handled by *C. Fred Gurnham*, head of the Department of Chemical Engineering, Michigan State College.

Whitfield Appoints Raney

Thornton Q. Raney

The appointment of *Thornton Q. Raney* as eastern representative of the *Whitfield Chemical Co.* has been announced by *C. Whitfield Smith*, company president. Located in Detroit, the firm manufactures industrial metal cleaning and finishing chemicals.

Raney will remain located in Philadelphia, with offices in the Land Title

Building. He has been a manufacturers' representative in the industrial field for several years.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

1954 CONVENTION

George Schore, chairman for the 1954 Convention, has had wide experience in all phases of metal finishing and is indeed well known in the Metropolitan area, both as a plater and one of the most active members in the A.E.S. He secured his degree as Bachelor of Science in Chemical Engineering from the College of the City of New York, taking evening courses while working as superintendent in several of the large plants in the area. At present he is a technical representative for the Frederick Gumm Chemical Co.

Mr. Schore has held all the offices of his local branch and for the past four years has been Secretary-Treasurer. His activities in the National Society are also a matter of record as are his technical papers which have appeared.

George Schore
General Chairman

George announces that several of the committees have long been functioning and have plans for what promises to be one of the finest conventions of the Society. *Milton Nadel*, educational chairman, has already received several papers for review by the Editorial Board and he promises sessions which will do credit to the Society. Milton has held office in the New York Branch for the past twelve years but promises to outdo himself in preparing an educational session which will long be remembered.

George Cooperman, chairman of the Exhibits Committee has contacted the Secretaries of the local branches for cooperation in completing several new ideas he wishes to present at this convention.

As mentioned previously, *Moe Ranno*, Visitors' Entertainment Committee Chairman, is at work on several requests which have come in. The working of the committee and places available to be visited will be "it is never too early to plan for entertainment during the convention." He also says that should visitors wish to attend an entertainment within a few days before or after the convention, he will be glad to arrange it.

Martin F. Maher, Jr. and *Albert G. Fusco*, Co-Chairmen of the Registration Committee, have developed a method for pre-registration which they believe will avoid confusion at the

Milton Nadel

Educational Chairman

registration desk during the convention. In the very near future forms will be made available for registration in advance of their arrival by people wishing to attend the convention. If for some unforeseen reason anyone who has pre-registered cannot attend the convention, the registration will be refunded.

It is hoped that by making these facilities available without any fear of loss of money that cooperation on making this experiment successful will be to the utmost and prove useful to future conventions. Where supply houses wish to take advantage of this innovation, it will be possible for them to register for all their representatives prior to the convention. As mentioned above, it is emphasized that money received for pre-registration will be returned in full where the registration is not picked up at the convention.

Both the above committees and their functions will be covered in greater detail in future releases.

Publicity Chairman *John Trumbour* has actively been seeing that the Convention is publicized in publications in the finishing field.

Dayton Branch

The Dayton Branch will hold its Ninth Annual Educational Session and Dinner-Dance on Saturday, February 27, 1954 at the Dayton Biltmore Hotel.

The Educational Session will begin at 1:30 P.M. and will feature the following speakers:

1. *A. R. Burman,* Cro-Plate Co., Inc., Hartford, Conn. Subject: Pressure Wet Blasting.
2. *R. O. Hull,* R. O. Hull & Co., Inc., Rocky River, Ohio. Subject: To be announced.
3. Third speaker to be announced.

The dinner-dance will be held at 7:00 P.M. For information regarding tickets or reservations contact *R. L. Ruleff,* 705 Hollendale Dr., Dayton 9, Ohio.

Syracuse Branch

The first fall meeting of the Syracuse Branch was a high-light in its history. On Sept. 18th about 160 members and guests visited Oneida Ltd. at Sherrill, N. Y. The afternoon was spent in touring the factories, with trained guides, under the capable direction of *Robert E. Pettigrew.* Special point in these tours was an inspection of the new waste-disposal plant.

Following the plant visitation a delicious dinner, with choice of turkey, or Oneida Lake pike was served through the courtesy of Oneida Ltd., in the Sales Office cafeteria.

At the technical session the group was officially welcomed by *Hamilton*

Allen, Works Manager, who expressed the hope that some of those present might contribute some ideas for the good of Oneida Ltd. He went on to explain that his own technical organization was too busy with outside activities to bother with work. For example *Ed. Jones* was principally concerned with getting the right shade of green for laboratory decor and his car, *Dan Gray* was involved in the mathematical theory of betting on horses at Vernon Downs and *Frank Mesle* divided his time between fishing and saving souls.

The speaker of the evening was *Prof. Charles A. Walker* of the Chemical Engineering Dept. of Yale University. Dr. Walker spoke on the subject of factory waste disposal with particular reference to the problems of Oneida Ltd. He pointed out that although not the largest plant of its kind, it is one of the most complete and capable of handling the complex problems of treating a complex factory effluent.

Of particular interest was Dr. Walker's description of the long and tedious preparatory work. This work involved a detailed analysis of every operation contributing to factory effluent as regards volume and composition, a study and partial rebuilding of drain lines and a tremendous amount of laboratory work, both at Yale and Oneida. He then went on to discuss the problems of designing the plant and those involved in its actual construction. Diagramatic flow-sheets were shown which made clear the various steps in treatment.

Since Dr. Walker had started from scratch on the waste disposal problem at Oneida Ltd., he was able to speak from experience in regard to all details.

A prolonged question period followed the talk. In this Dr. Walker was assisted by *John Madden*, construction engineer. The large number and variety of questions asked evinced keen interest in the subject.

Another evidence of the wide-spread interest in the subject of industrial waste treatment was the number of out-of-town guests. Among the notables present were: *Bertie Daw*, St. Louis, Mo.; *Dave Clarin*, New York; *Bill Fotheringham*, Buffalo; *Wesley L. Cassell*, Waterbury, Conn.; *W. W. Chace*, Long Island City; *Leonard T. Crenan*, Philadelphia, Pa.; *A. H. Kirkpatrick*, Detroit, Mich.; *Ted Infield*, Schenectady; *Michael Lucas*, Scranton, Pa.; *Gerry Lux*, New York; *Leonard Rood*, Halstead, Pa.; *Edwin Wallin*, Rochester; *Ted Duvall*, Saratoga Springs; and many others too numerous to mention.

Lindley S. Wood, Sec.

Louisville Branch

The regular monthly meeting of the Louisville Branch, was held Thursday, October 15, 1953, at Korfhage's Restaurant, 1482 Preston St., Louisville, with a dinner served at 6:30 P.M. President, *P. H. Pate* opened the business and open meeting at 8:00 P.M. with twenty-eight members and guests present.

The roll call of officers was read and Board of Managers, *E. W. Eckerle* and *Thomas K. Allison* were reported absent. The minutes of the previous meeting were read and accepted.

Technical Sessions Chairman, *Stanley J. Beyer*, reported that the speakers for the November meeting will be *Franklyn MacStoker*, Past President and *P. Peter Kovatis*, Executive Secretary of the Society, representing the headquarters staff. Their subject is,

"Things You Should Know About The A.E.S."

Charles R. Bohannon, RR-3, Box 438A, Jeffersonville, Indiana, applied as Active Member.

A letter from *W. L. Pinner*, International Council Representative from the Society to the *Institute of Metal Finishing* of England, was read and ordered to be placed on file.

President Pate decided to bring up the Regional Meeting situation to fore. After some discussion he appointed *William B. Drake* as the Louisville Branch representative to attend these sessions.

The meeting was turned over to Educational Chairman Beyer who, after a brief talk, introduced *C. Claude Weekly*, Service Manager of Promat Division of Poor & Co., Waukeegan, Ill., and president of the Indianapolis Branch A.E.S. for the present fiscal year. Mr. Weekly in his talk on zinc plating delved into the history of plating and its procedure in the early days.

Considerable discussion followed and Mr. Weekly was given a rising vote of thanks for a very interesting talk.

Following this a General Electric Company film entitled, "Clean Waters" was shown.

Meeting adjourned at 10:30 P.M.

Joseph G. Sterling,
Secretary-Treasurer

Bridgeport Branch

The regular business and educational session of the Bridgeport Branch was held in the executive suite of the Hotel Barnum on Friday, November 13, 1953. President *Consalvo* called the meeting to order at 8:15 P.M., at which time 43 members and guests were present. At the roll call of officers *Bill Ehrencrona* and *Geo. Wagstaff* were absent. Pres. Consalvo presented the applications for membership of the following: *John R. Morriss*, *Emil E. Berger*, *John D. Shamiss* and *Arthur Beibel*.

Jack Winters, of R. O. Hull & Co., was the featured speaker of the evening. His subject, "Bright Cadmium and Zinc Plating," was received with special interest by the members attending. An outline of the preparation of zinc and cadmium baths for still, automatic and barrel plating was the opening phase of his talk. The functions of the constituents of the baths were carefully analyzed. The importance of Hull Cell analysis was of special interest, as were the use of proprietary brighteners, their effects and conservation. He strongly recommended daily analytical checks for the constituents of the bath, zinc metal, total cyanide, caustic soda.

At 9:45 P.M. the educational session was adjourned and the group repaired to the television room for refreshments. *Raymond Goral* of Enthone was host for the evening.

Robert Parker,
Secy.-Treas.

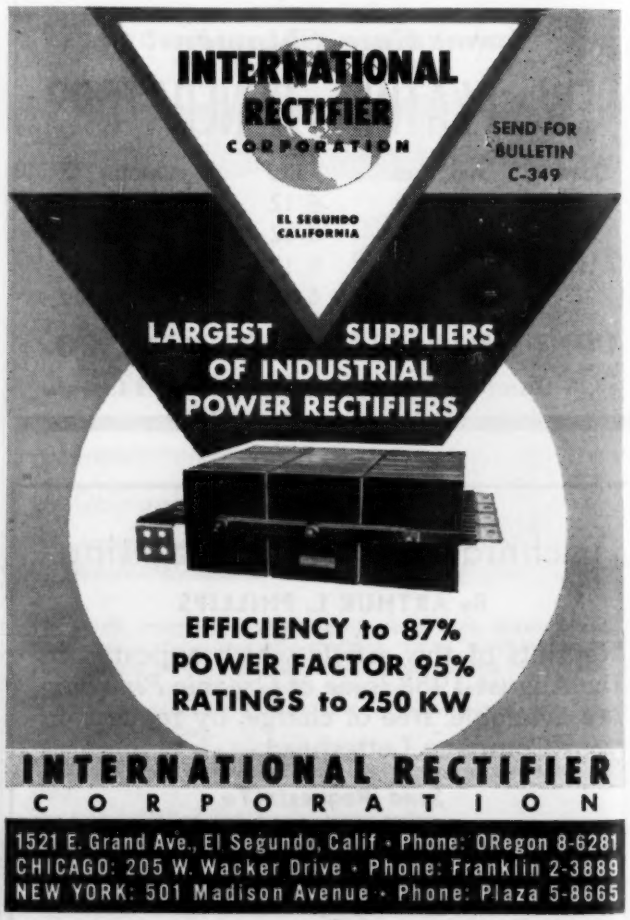
Baltimore-Washington Branch

On Tuesday, November 10, 1953, at 8:00 P.M., the Baltimore-Washington Branch held a meeting at the Park Plaza Hotel in Baltimore.

The meeting consisted of a very interesting treatise on Vacuum Metalizing given by Dr. Strong, followed by an equally interesting question and answer period on it and associated subjects.

Chicago Branch

About 50 members turned out for the November 13th meeting of the



Chicago Branch. The topic for the educational session was Wet Blasting, ably presented by *H. Berman* of the Cro-Plate Company of Hartford, Conn.

In his presentation, Mr. Berman first discussed the fundamental principles of wet blasting and described the equipment used for various wet blasting jobs. He followed this with a description of various types of problems solved through an application of wet blasting techniques. Mr. Berman's talk was followed by an extended and rather spirited discussion period.

The Chicago Branch would like to extend a cordial invitation to its 42nd Educational Sessions and banquet to be held January 30th, 1954.

Dr. Russel Harr, Branch Librarian has assembled three well qualified speakers to speak on the following subjects of current interest:

Lloyd Gilbert of the Rock Island Arsenal will speak on "Alkaline Derusting as a Modern Plating Tool." Mr. Gilbert is well known to members of the Society for his enthusiastic interest in and thorough investigations of new developments in processes related to metal finishing.

Dr. Allen G. Gray, Technical Editor of *Steel* will speak on "What's Ahead in Plating." Dr. Gray's background of 12 years with Du Pont, director of a group at the University of Chicago concerned with metallurgical and plating problems of the Manhattan project, Technical Editor of Steel and Editor-in-Chief of the new edition of "Modern Electroplating" eminently fit him for this discussion.

Harry W. Howard of the Shell Chemical Corp. will speak on "Organic Finishes Based on Epon Resins." New organic finishes based on epoxy resins promise to be more revolutionary than those made from alkyds.

On the lighter side, your reporter sat in on a meeting of the banquet committee which preceded the regular meeting. Take it from us *Ed Stanek* and his committee are brewing a bang up "banquup." Along with a fine meal those attending the banquet will be served an equally fine evening of entertainment.

Good luck and best wishes to *Mike Brave* who left B. Mercil & Sons to take over as general superintendent for United Platers in Detroit. Now Chicago Branch looks forward to *Walter Lockerbie* assuming an active role in branch activities as he assumes the supervisory duties at Mercil.

And last, but certainly far from least, welcome to the Electroglo Company which has just joined the Society as a sustaining member.

Jerome Kudema

Indianapolis Branch

First vice-president, *Elmer Lundberg*, presided at the December 2nd meeting at Fox Steak House. President, *Abraham Max*, was out of town on business. Thirty-five members and guests came for the dinner and six others came for the meeting and program.

After introductions the secretary's report was read and accepted. The treasurer gave a financial statement of the branch and it was accepted. One new member was voted into the society in a motion by *Robert Bruck* and seconded by *John Holland*. He is *Mitchell G. Osman*. *Robert VanHouten*, general chairman of the spring dinner-dance reported progress and stated he has five volunteers for some of the

various jobs. He will appoint others if these jobs are not asked for.

The branch was given a report about the campaign to have *Tom Evans* elected as third vice-president of the Supreme Society. Ed Bruck said the wheels of progress are moving and a letter will be mailed this month to all branch secretaries and past presidents. Another letter will follow in April. Mr. Evans and Mr. Bruck plan to attend the Interim Meeting in February in Toronto, Canada. The vice-president asked all members to do some politicking at any other branch meeting they may attend.

As nothing was allowed towards the expenses of the secretary to the Philadelphia convention, a motion by Mr. VanHouten and seconded by *Roman Bender* was passed to pay $75.00 to the secretary. The motion was carried.

Another motion by *Quentin Shockley* and seconded by Mr. Bender was that the branch pay fifty cents per year per member beginning January 1, 1954 to each the secretary and treasurer. After discussion this motion was passed.

Librarian Bender, introduced the speaker of the evening who was *Dr. Harold Weisner* of Bendix Corporation, South Bend. His subject was "Tobacco Rhodium" or "Don't spit in the plating tank," which proved to be a very enlightening subject on the plating of Rhodium. Some of its qualities are its hardness, corrosion resistance, free of any film and very expensive to operate. He showed several slides and pictures and also had one part to show the group which had been plated with rhodium in the Bendix Laboratories. This part was one for a jet engine. As most of the group knew little or nothing about the subject, it proved very interesting and afterwards it was found out why Dr. Weisner gave the above title to his talk. Rhodium plating is very susceptible to any foreign matter.

After discussion on the above subject, the meeting adjourned at 9:15 P.M.

Edna Rohrbaugh,
Secretary

New York Branch

Held October 23, 1953 at the Hotel Statler, New York, the meeting was called to order by *A. Amatore,* president. Roll of officers was called and *J. Sterling* was noted absent. The minutes of the previous meeting were read and approved.

President Amatore had the pleasure of announcing the presence of *A. Korbelak*, editor of *Plating*. He also announced the appointment of *G. Cooperman* as exhibit chairman for the National Convention.

Milton Nadel presented to the Society a check of $100.00 from the Prime Plating Co., as a sustaining member.

There being no other business, the meeting was turned over to *Peter Veit*, librarian, who presented *Mr. Goebels* of the American Smelting and Refining Co. Mr. Goebels' talk was on "Anodes and Anode Functions," which was most interesting.

Lester Levinson,
Recording Secretary

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

CORROSION SHORT COURSE

Program plans for the 1954 annual short course in corrosion held by the *National Association of Corrosion Engineers* are well under way, accord-

ing to *Dr. M. F. Adams*, N.A.C.E. program chairman and associate chemist, Division of Industrial Research, Washington State College. The five-day course to be held on the campus of Washington State College at Pullman, February 1-5, 1954, will present a brief but intensive review of the fundamental aspects of corrosion followed by panel discussions and lectures on the applications of corrosion control in industry. The Division of Industrial Services of the Washington State Institute of Technology is the college sponsor of the course.

The program includes five general topics — fundamentals, practical aspects, corrosion mitigation, materials of construction, and environment. Following are representative presentations to be made under each topic:

Fundamentals: Physiochemical and Metallurgical Factors, H. H. Uhlig, Professor of Metallurgy, Massachusetts Institute of Technology.

Practical Aspects: Corrosion Testing and Evaluation, F. L. LaQue, Corrosion Engineering Section International Nickel Company.

Corrosion Mitigation: Cathodic Protection and Inhibitors, G. H. Rohrback, Consulting Corrosion Engineer.

The Environment: Process Industry, Aaron Wachter, Chief, Corrosion Research, Shell Development Company.

For further information address requests to Professor E. B. Parker, Director, Division of Industrial Services, State College of Washington, Pullman, Washington.

N. F. M. F.

First Management Seminar Slated by Job Shop Metal Finishers for January in Chicago

The National Federation of Metal Finishers will hold its first Management Seminar at the Conrad Hilton Hotel, Chicago, on Saturday, January 30, 1954.

Meeting concurrently with the Chicago Branch, A.E.S., Annual Educational Sessions and Banquet, the job shop group will present an all-day program featuring top-flight speakers on a series of Management topics.

Federation president *Philip Ranno*, Imperial Plating Co., Brooklyn, N. Y., has appointed *J. Robert Greenwell*, Chrome-Rite Co., Chicago, General Conference Chairman. In announcing the details of the event, Greenwell explained that the need for such seminars is growing rapidly with our changing economy. "The National Federation of Metal Finishers feels that management leaders in the metal finishing industry can profit through the free exchange of ideas, methods and techniques being applied in other industries."

Invitations have been sent to owners and operators of metal finishing job shops, as well as to managers of finishing departments in manufacturing establishments. Greenwell reported that this first seminar is being sponsored by the National Federation of Metal Finishers as a service to the industry, and that no admission fees will be charged.

The Program for the four sessions of the seminar is as follows:

9:30 A.M.—"Work Simplification Programs for the Metal Finisher"—*S. J. Fecht*, president, S. J. Fecht & Associates, Management Consultants, Chicago.

10:30 A.M.—"Laying Out Produc-

tion Lines for a Job Shop"— *John B. Thorsen*, executive assistant, Atwood Vacuum Machine Co., Rockford, Ill.

2:30 P.M. — "Budgetary Controls for Small Business Establishments"— *H. J. Hubenthal*, president, Electran Mfg. Company, Chicago.

3:30 P.M.—"Organizing Your Business for Tax Advantages" — *Max Becker*, Max Becker & Company, Certified Public Accountants, Chicago.

Paul Glab, Northwestern Plating Works, Chicago, is chairman of the Liaison Committee of the Chicago Branch, A.E.S., which is working with the National Federation in planning this first conference.

A second Management Seminar is being planned for July in New York City, during the 41st Annual Convention of the A.E.S.

Manufacturers' Literature

Portable D-C Indicating Instruments

General Electric Company, Dept. MF, Schenectady 5, N. Y.

A new bulletin on portable d-c indicating instruments has been announced as available.

Designated GEC-979A, the 8-page illustrated publication provides information on the applications, features, prices and performance of the company's Type DP-11 and DP-12 instruments.

Self-Sticking Special Markers and Labels

W. H. Brady Co., Dept. MF, 727 West Glendale Ave., Milwaukee 12, Wis.

A new colorful bulletin containing practical, cost-cutting solutions to many special industrial industrial marking problems has just been published.

Actual-size illustrations of pressure-sensitive markers and labels, tailor-made for special applications, are shown in three colors. Included are Trade Marks, instruction, inspection, part numbers, Underwriters' and serially numbered labels.

A dispenser card containing a variety of special labels made to customers' specifications is sent free of charge with each copy of the new bulletin. Ask for Special Marker Bulletin No. 132.

Water Demineralizer

Penfield Manufacturing Co., Inc., Dept. MF, 19 High School Ave., Meriden, Conn.

The new brochure, describing the latest model Penfield permanent cartridge demineralizer with laboratory stand, illustrates this extremely efficient laboratory demineralizer in use (flow rate: up to 10 gallons per hour) and also shows an operation diagram.

The unit makes super high purity water "as handy as your tap." All that is necessary to set it in operation is

to connect influent hose to tap and turn on water to proper flow rate as visually indicated by the exclusive Penfield flowmeter.

Only maintenance required is occasional simple replacement of the Pennex resin charge in the permanent cartridge, when the unit's electric conductivity (purity) meter indicates such to be desirable.

Furnished with an aluminum bracket for easy mounting on wall near a tap or in a convenient counter stand (accessory), the complete unit is light, compact and requires only 28" x 6" x 6" storage space when not in use.

Plastics and Vacuum Metallizing Glossary

Red Spot Paint & Varnish Co., Dept. MF, 110 Main St., Evansville 8, Ind.

The above firm, specializing in industrial organic coatings for vacuum metallizing, announces the availability of its glossary of terms used in the coating of plastics and vacuum metallizing of metals. Such terms as metalescent and pearlescent coatings are defined.

For further information please contact the firm at the above address.

Industrial Spray Nozzle Catalog

Spraying Systems Co., Dept. MF, 3201 Randolph St., Bellwood, Ill.

The above manufacturer has just announced "the most comprehensive industrial spray nozzle catalog ever printed." This complete reference catalog contains 48 pages . . . and is identified as Catalog No. 24. Thousands of standard and special industrial spray nozzles are illustrated and described. For each nozzle, complete data is listed covering capacity and spray angle. Dimensional specifications for all standard nozzles are also given.

Because the information in Catalog No. 24 is so extensive, a new type of index was designed to assist the reader in finding desired data. Spray nozzles are indexed in terms of "Spray Patterns." The six main headings are "Hollow Cone, Full Cone, Square Spray, Flat Spray, Straight Stream and Air Atomizing." In addition to spray nozzles, information is supplied on a wide variety of related equipment such as line strainers, elbows, check valves, and adjustable joints. For handy use by the engineer, tables are included on spray coverage and pipe frictions.

Consolidated Solvents Data Chart

John B. Moore Corp., Dept. MF, Lee Building Nutley 10, N. J.

Complete physical specifications of eight "solvents engineered for safety" are now shown on a single consolidated data chart, "CD", offered by the company.

ADVERTISING RATES
Per column inch per insertion

1 time	$10.00
3 times	9.00
6 times	8.50
Yearly (12 times)	8.00

READY-REFERENCE SECTION
—USED EQUIPMENT AND SUPPLIES—

ELECTROPLATING
POLISHING
RUST PROOFING
CLEANING
ANODIC TREATMENT
ETC.

FOR SALE

PLATING MOTOR GENERATOR SETS (REBUILT) WITH COMPLETE PANEL EQUIPMENT — MOTORS — 3 PHASE, 60 CYCLE, 220/440 VOLT.

1—HANSON VAN WINKLE MUNNING 1000 ampere, 3-40 volt, interpole, 900 RPM, Exciter in head. Synchronous motor. Ser. #11152.

1—EAGER ELECTRIC 5000/2500 ampere, 6/12 volt, 514 RPM, separately excited. Ser. #1844.

1—BENNETT & O'CONNELL 2000/1000 ampere, 6/12 volt, 680 RPM, separately excited. Ser. #3926.

1—HANSON VAN WINKLE 2000/1000 ampere, 6/12 volt, 550 RPM Self Excited. Ser. #3513.

1—BOGUE ELECTRIC 1000/500 ampere, 6/12 volt, interpole, 1165 RPM, Exciter in head. Ser. #2015.

1—CHANDEYSSON ELECTRIC 600/300 ampere, 6/12 volt, 1140 RPM self excited. Ser. #12300.

FOLLOWING SETS SYNCHRONOUS — 3 phase, 25 cycle, 220/440 volt — COMPLETE.

1—ELECTRIC PRODUCTS 1500/750 ampere, 6/12 volt, 375 RPM, Exciter in Head. 25 Deg. C. Ser. #291195.

1—CHANDEYSSON ELECTRIC 3000/1500 ampere, 6/12 volt, 375 RPM, Exciter in head. 40 Deg. C. Ser. #26174.

POLISHING LATHES — NEW AND USED — CONSTANT AND VARIABLE SPEED, SINGLE AND DOUBLE MOTOR DRIVES — 3 phase, 60 cycle, 220/440 volt, 1 to 20 H.P. — IN STOCK.

REBUILT RECTIFIERS — GREEN — UDYLITE — GENERAL ELECTRIC — SELENIUM — 50 to 6000 ampere sizes, 6/12 volt with regulators, 3 phase, 60 cycle, 220/440 volt.

1—30 ft. x 5 ft. x 4 ft. — 60 hanger, BELKE SEMI-AUTOMATIC PLATING MACHINE, RUBBER LINED. LIKE NEW — used 3 months. (Priced to sell.)

MERCIL — CROWN — BAIRD — LASALCO — GLOBE — BURNISHING AND TUMBLING BARRELS.

NEW SELENIUM RECTIFIERS, complete with instruments, starter and built-in voltage regulators —

1500 ampere, 0-12 volt
1500 ampere, 3-6 volt
2000 ampere, 0-12 volt
2000 ampere, 0-9 volt

ALSO AVAILABLE — OTHER NEW AND USED POLISHING LATHES, BARRELS, RHEOSTATS, RECTIFIERS, FILTERS, BLOWERS AND GENERATOR SETS. WE CARRY A COMPLETE LINE OF NEW AND USED PLATING AND POLISHING EQUIPMENT AND SUPPLIES.

CLINTON SUPPLY COMPANY

112 South Clinton Street
Chicago 6, Illinois
FRanklin 2-3753

PRICED RIGHT FOR QUICK SALE!

2—Baird #2 Ball Burnishing (tumblers) machines with wood lined cylinders, arranged for belt drive complete with sieves, shaker and covers.

3—Assorted tumblers — tilting type, bottle type with rubber lined cylinder and horizontal wet type.

1—rubber lined tank 54" long x 24" wide x 30" deep. (Ideal for nickel or silver) — many others, lined or unlined.

1—Nankervis Automatic Compound Applicator—motor driven single phase, 115 volts, A.C. Ideal for use with semi or fully automatic buffers (new).

3—Polishing Machines 3 H.P., 5 H.P. and 10 H.P. Devine and U. S. Electrical Tool (direct driven and motor in base).

2—Gardner 3D Buffers with two 5 HP motors each with cluteh for single shaft operation (double 5 H.P.)

10—Tank Rheostats — 50 amperes — 100 amperes — 200 amperes and 500 amperes — all with meters and shunts.

2—LaSalco Portable Plating Barrels suitable to acid solutions complete with single phase motors.

1—Detrex Steam Heated Stainless Steel Degreaser 11 ft. long x 5 ft. wide x 8 ft. deep complete with hood, blower and motor, flush spray.

Plating Tanks — all sizes and linings.
Rectifiers — 25 amperes to 10,000 amperes.
Airbuffs — compounds — anodes — chemicals, etc.

For Quality, Dependability & Service Call On:

BRUCAR EQUIPMENT & SUPPLY CO.
Box 433 Hempstead, L. I., N. Y.
Telephone: HYacinth 8-6122

FOR SALE

Available for Immediate Delivery

•

REBUILT AND GUARANTEED EQUIPMENT FOR

- POLISHING
- ELECTROPLATING
- SPRAYING
- METAL FINISHING

•

Motor Generator Sets, Rectifiers, Wood, Steel, Lead Lined and Rubber Lined Tanks, Steam Boilers, Rheostats, Polishing, Buffing and Grinding Machines and everything needed for a modern metal finishing department.

Equipment Bought, Sold & Exchanged.
Send us your list of surplus equipment.

H & S EQUIPMENT & SALES CO.

31 Johnson Ave., Brooklyn 11, N. Y.
EVergreen 7-2526

COMPLETE PLATING PLANT FOR SALE

Rectifiers; 5 vats, 2' x 2' x 5' made of 2" wide single cypress boards; buffer; scratch brusher; pickling vats; drying asbestos box; nickel, copper, silver, gold anodes, salts and solutions; hundreds of buffs; scratch brushes, etc. $4,000 cash. Phone, write or wire for details.

MOSES GEORGE JEWELRY
711 W. Third St., Thibodaux, Louisiana
Phone No. 3466

IMMEDIATE SHIPMENT, ATTRACTIVE VALUES

THE FOLLOWING EXCELLENT REBUILT AND GUARANTEED ELECTROPLATING MOTOR GENERATOR SETS AND RECTIFIERS WITH FULL CONTROL EQUIPMENT:

— PLATERS —

1—**7500/3750 Amp., 6/12 V., Munning "Optimus".**
1—**5000/2500 Amp., 8/16 V., Electric Prod., 25°C.,** Synch., Exc.-in-head.
1—**5000/2500 Amp., 9/18 V., Columbia.**
1—**5000/2500 Amp., 7/14 V., Chandeysson, 25°C.,** Exc.-in-head.
1—**5000/2500 Amp., 6/12 V. Chandeysson, 25°C.,** Synch., Exc.-in-head.
1—**4000/2000 Amp., 6/12 V., Chandeysson, 25°C.,** Synch., Exc.-in-head.
1—**3000/1500 Amp., 6/12 V., Electric Prod.,** Synch., Exc.-in-head.
1—**3000/1500 Amp., 6/12 V., Columbia,** Synch.
1—**2000/1000 Amp., 8/16 V., Electric Prod.**
1—**2000/1000 Amp., 6/12 V., Electric Prod.,** Synch.
1—**1500/750 Amp., 6/12 V., H-VW-M,** Synch., Exc.-in-head.
1—**1500/750 Amp., 12/24 Volt, Chandeysson,** Synch., Exc.-in-head.
1—**1000/500 Amp., 6/12 Volt, Electric Prod.**

— ANODIZERS —

1—**4000 Amp., 40 V., Chandeysson,** Exc.-in-head.
2—**1000 Amp., 30 V., Ideal,** Exc.-in-head.
1—**1000 Amp., 40 V., Chandeysson, 25°C.**
1—**500 Amp., 25 V., Chandeysson,** Synch. Exc.-in-head.
1—**400 Amp., 40 V., M.G.C.,** Exc.-in-head.

— RECTIFIERS —

BRAND NEW BASIC RECTIFIERS, 1500/750 amperes, 6/12 volts. Special Price: $750.00 each. Separate Voltage Controls available.
1—**2000 Amp., 6 V., G. E. Copper Oxide,** & Control.
1—**Green Selectoplater, 1800 Amp., 12 V.,** 220/3/60.
1—**Udylite-Mallory, 1500/750 Amp., 6/12 V.,** & Control

— SPECIAL —

1—**Mercil 12 x 12 Centrifugal Dryer,** Elec. Heat.
1—**Kreider 12 x 12 Centrifugal Dryer,** Steam Heat.
1—**Crown 18 x 18 Centrifugal Dryer,** Steam Heat.
4—**24" and 30" Robbins & Myers 2-Speed Ventilating Fans.**
3—**#1 Hartford Triple-Action Burnishing Barrels,** Lined and Unlined, Belted.

Above is partial list only. Write to us for all your requirements for Plating, Anodising and Metal Finishing.

WIRE - PHONE - WRITE

M. E. BAKER COMPANY

25 WHEELER STREET, CAMBRIDGE 38, MASS.
Phone: Kirkland 7-5460